16.53
578

SCIENCE ABSTRACTS: SECTION A 843–1406

VOLUME 61

PHYSICS ABSTRACTS

UMBER 723

ARCH 1958

Published by The Institution of Electrical Engineers

UNIVERSITY OF ILLINOIS
LIBRARY
APR 14 1958
CHICAGO

SECTION A OF SCIENCE ABSTRACTS

Edited and issued by THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, London, W.C.2 © 1958

Published monthly in association with THE PHYSICAL SOCIETY, THE INSTITUTE OF PHYSICS, THE AMERICAN PHYSICAL SOCIETY, AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Co-operating member of the I.C.S.U. Abstracting Board (International Council of Scientific Unions)

Physics Abstracts

	PAGE
MATHEMATICS	81
ASTRONOMY. ASTROPHYSICS	81
PHYSICS	83
Fundamentals	83
General mechanics. Mechanics of solids	85
Mechanical measurements	86
Mechanics of fluids	86
Molecular theory of liquids	86
Mechanics of gases	86
Molecular theory of gases	87
Vibrations. Acoustics	87
Optics. Radiation. Spectra	89
Heat	95
Thermodynamics	—
Electricity	97
Electrostatics. Dielectrics	97
Electric conduction. Currents	98
Electric discharges	101
X-rays	102
Cathode rays. Positive rays	102
Discharge tubes. Ionization. Thermionics	103
Cosmic rays	104
Magnetism	105
Electromagnetism. Electrodynamics	106
Electromagnetic waves and oscillators	106
Nuclear and atomic physics	107
Apparatus. Particle detectors	107
Elementary particles	108
Nucleus	113
Radioactivity	114
Nuclear reactions	116
Atoms	118
Molecules	120
Solid-state physics	121
Structure of solids	124
Elasticity. Strength. Rheology	125
PHYSICAL CHEMISTRY	127
Phase equilibrium. Chemical reactions	127
Electrochemistry	—
Photochemistry. Radiation chemistry	127
Dispersions. Colloids. Adsorption	128
Chemical structure	128
Chemical analysis	128
CRYSTALLOGRAPHY	128
X-ray crystallography	128
GEOPHYSICS	129
Atmosphere. Meteorology	129
BIOLOGY	130
Medical science. Human physiology	130
TECHNIQUE. MATERIALS	132
Photography	132

The number printed above each abstract on the right is the Universal Decimal subject classification number; the abstracts are arranged in order of these numbers throughout each issue.

The monthly Author Index, List of Journals, Errata and Notes follow immediately after the last page of abstracts.

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Electrical and magnetic measurements and instruments	Waveguides	Oscillators. Pulse circuits
Electronic relays and counters	Transistors	Amplifiers
Automatic control mechanisms	Photocells	Electroacoustic apparatus
Applied electrochemistry	Thermionic tubes	Radiocommunication
Lines and networks	Cathode-ray tubes	Mechanical engineering
	X-ray tubes	Illumination

Committee of Management 1957–58

THE INSTITUTION OF ELECTRICAL ENGINEERS

THE PRESIDENT (*ex officio*)
L. G. BRAZIER, Ph.D., B.Sc., M.I.E.E.
J. A. BROUGHALL, B.Sc.(Eng.), M.I.E.E.
L. HARTSHORN, D.Sc., M.I.E.E.
R. L. SMITH-ROSE, C.B.E., D.Sc., Ph.D., M.I.E.E.

THE PHYSICAL SOCIETY

J. H. AWBERY, M.A., B.Sc.
W. R. S. GARTON, B.Sc.
D. ROAF, M.A., D.Phil.
MISS A. C. STICKLAND, M.Sc., Ph.D.

THE INSTITUTE OF PHYSICS

L. R. G. TRELOAR, B.Sc., Ph.D., D.Sc. F.Inst.P.

THE ROYAL SOCIETY

T. E. ALLIBONE, D.Sc., Ph.D., M.I.E.E., F.R.S.

THE CENTRAL ELECTRICITY GENERATING BOARD

H. W. GATEHOUSE, A.M.I.E.E.

OBSERVER FOR THE AMERICAN PHYSICAL SOCIETY

R. T. WEBBER, B.A., M.S., Ph.D.

Editorial

EDITOR

B. M. CROWTHER, M.A., Ph.D., F.Inst.P.

ASSISTANT EDITORS

N. R. FOWLER, A.R.C.S., D.I.C., F.Inst.P.
R. W. PRIOR.
A. TYBULEWICZ, B.Sc.
L. MACQUISTEN WALLACE, B.Sc., A.M.I.E.E., A.M.I.E.(Aust.).

Annual Subscriptions

Science Abstracts is published in two sections, available separately:
Section A, *Physics Abstracts*: £6 0 0.
Section B, *Electrical Engineering Abstracts*: £5 0 0
Both sections, £10 0 0.

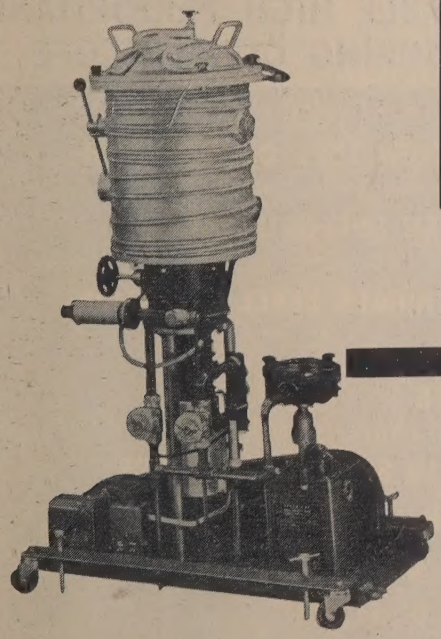
Printed on one side only, for mounting on cards (indexes on request only):
Section A, £7 0 0; Section B, £6 0 0;
both sections, £12 0 0.

The Institution of Electrical Engineers, Savoy Place, London, W.C.2. Telephone: Temple Bar 7676.

VACUUM METALLURGY

With the aid of a "SPEEDIVAC" VACUUM FURNACE vacuum metallurgy may be explored for the improvement of your product without involving the big expense of large-scale industrial equipment. This MINIATURE vacuum furnace has all the operational advantages of the industrial equipment enabling VACUUM MELTING . . . CASTING . . . ANNEALING . . . SINTERING . . . VACUUM BRAZING . . . to be carried out up to temperatures of 1700°C.

. . . puts 'Super-Muscles' Into Common Metals!



"SPEEDIVAC" RESEARCH VACUUM FURNACE
½ lb CAPACITY

For better vacuum service . . .

EDWARDS HIGH VACUUM LTD

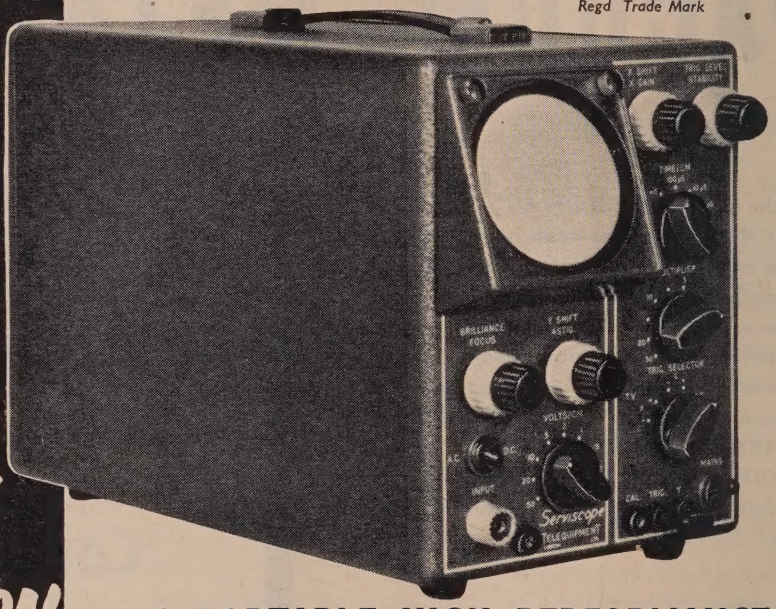
MANOR ROYAL · CRAWLEY · SUSSEX CRAWLEY 1500 (10 LINES) EDCOHIVAC CRAWLEY

THE SERVISCOPE

Regd Trade Mark

DC TO 6 MC/S

TIME AND VOLTAGE CALIBRATION



A PORTABLE HIGH PERFORMANCE MEASURING OSCILLOSCOPE

★ **INCORPORATES AN ENTIRELY NEW TYPE OF TIME BASE**
formerly only available on the most expensive American oscilloscopes.

★ **18 PRE-SET CALIBRATED SWEEP SPEEDS FROM**
.5 sec/cm to 1 μ sec/cm

★ **AUTOMATIC TRIGGERING OR TRIGGER LEVEL SELECTION**

★ **DC COUPLED UNBLANKING**

★ **9 CALIBRATED Y SENSITIVITIES**
FROM 100 mV/cm to 50V/cm ALL DC TO 6 Mc/s

★ **SWEEP EXPANSION TO OVER 10 SCREEN DIAMETERS**

★ **BUILT-IN TV SYNC SEPARATOR**

★ **ULTRA BRIGHT 3″ FLAT FACE CRT**

★ **COMPLETELY PORTABLE 8″ x 6″ x 12″**

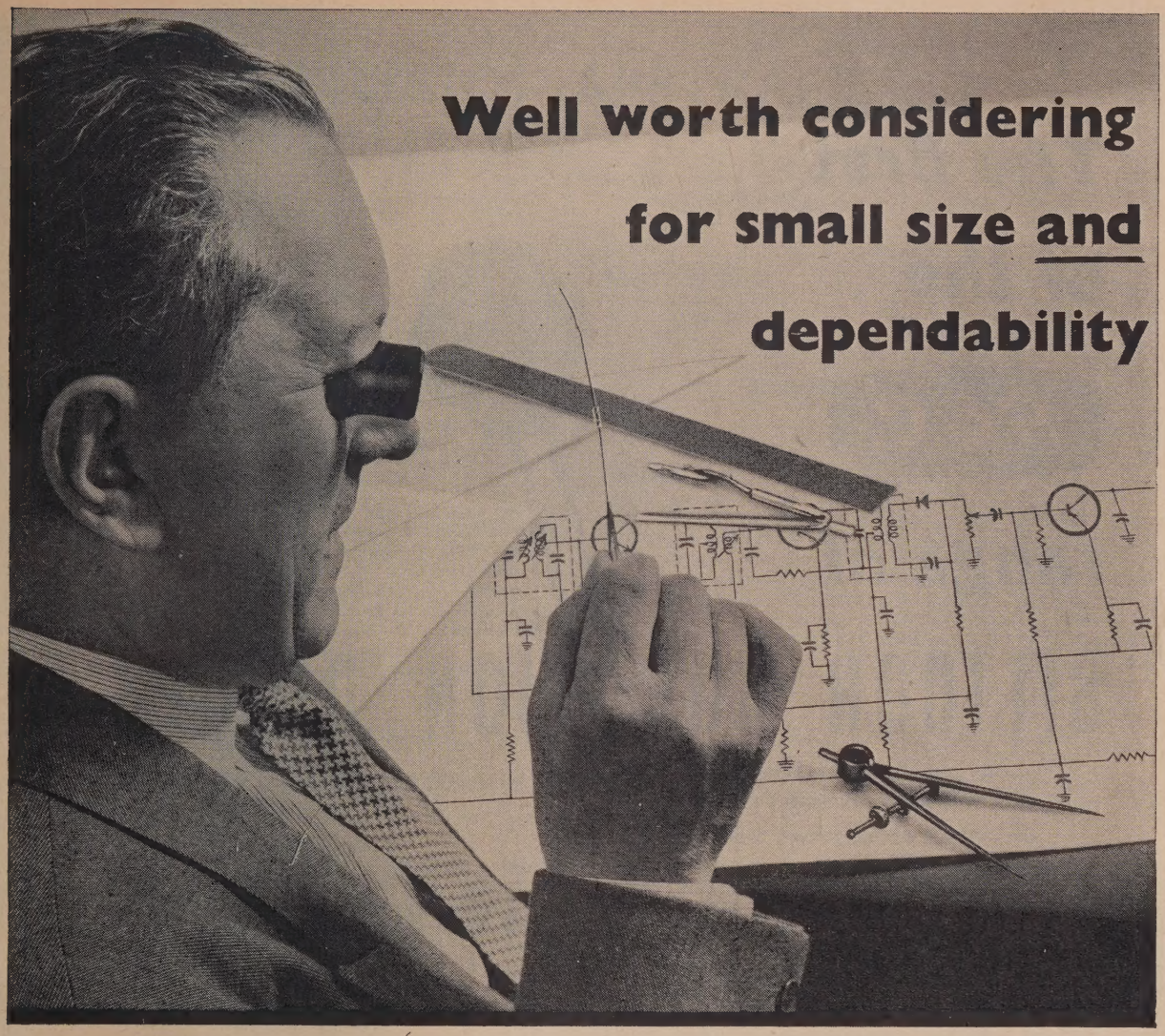
THE FINEST, MOST VERSATILE

portable oscilloscope ever offered to the electronics industry.

Write for fully illustrated leaflet.

TELEQUIPMENT LTD

313 Chase Road, Southgate, London N.14. PALmers Green 7111



Well worth considering for small size and dependability

The new type BTH Germanium Point Contact Rectifiers—

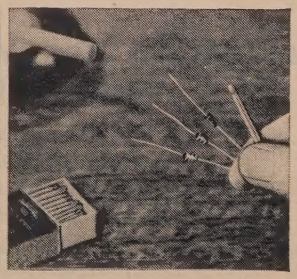
Only ¼ in. long, yet their miniature size is combined with high performance and complete dependability! They offer the following outstanding characteristics:

- HIGH TEMPERATURE STABILITY
- ABILITY TO WITHSTAND TROPICAL CONDITIONS
- SMALLER DIMENSIONS
- VERY LONG LIFE

RATINGS: CONTINUOUS OPERATION AT 25°C. (77°F.)

TYPE	PEAK INVERSE VOLTAGE† V	MAX. INPUT CURRENT mA	MAX. RESISTANCE at + 1 volt ohms	MIN. RESISTANCE at — 50 volts kilohms
CV 448*	80	30	333	500
CG41-H	65	30	250	50
CG42-H	100	30	500	1,000
CG44-H	80	30	333	500
CG50-H	100	30	500	200

*Type CV 448 has been granted 'type approval'. †Corresponds to 1·2 mA inverse current.



B T-H

BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON CO·LTD·LINCOLN·ENGLAND

an A.E.I. Company

A 5162

The first of the G.E.C. range of

SILICON JUNCTION DIODES

For High Temperature Operation with extremely high ratios of forward to reverse resistance.

SX641 SX642 SX643 SX644

These diodes utilise a recently developed glass—pure copper seal which has made possible the production of devices with really outstanding thermal properties.

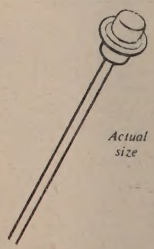
LOWER VOLTAGE TYPES SX641 SX642

Suitable for use as Second Detectors at frequencies of up to 10 Mc/s and for the majority of other low power circuit functions including Magnetic Amplifiers.

HIGHER VOLTAGE TYPES SX643 SX644

Suitable for use as H.T. rectifiers in telecommunication type power supplies, and for Blocking and Gating functions.

Typical ratings for capacitive input circuits at ambient temperatures of less than 75°C are given below:—



Actual size

Circuit Arrangement	Number of Diodes	Max. Rectified Current (mA)	R.M.S. Input Voltage (V)		D.C. Output Voltage (V)	
			SX643	SX644	SX643	SX644
Half-wave	1	100	64	106	90	150
Bi-phase	2	200	64-0-64	106-0-106	90	150
Bridge	4	200	128	212	180	300

For further information, write to the G.E.C. Valve and Electronic Department

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2.

PHYSICS ABSTRACTS

Volume 61 MARCH 1958 Number 723

MATHEMATICS

517.6 : 537.311.33

843. THE INTEGRALS $\mathfrak{A}_p(x) = (p!)^{-1}\int_0^\infty \epsilon^p(\epsilon + x)^{-1}e^{-\epsilon}d\epsilon$ AND $\mathfrak{B}_p(x) = (p!)^{-1}\int_0^\infty \epsilon^p(\epsilon + x)^{-2}e^{-\epsilon}d\epsilon$ AND THEIR TABULATION.

R.B.Dingle, D.Arndt and S.K.Roy.
Appl. sci. Res. B, Vol. 6, No. 3, 144-54 (1956).

These integrals are fundamental to the theory of the properties of weakly degenerate elemental semiconductors at high frequencies and/or in the presence of a steady uniform magnetic field, when conditions are such that scattering by thermal agitation or by neutral impurities predominates over ionic scattering. Their applications and properties are discussed, and various expansions and relationships to other functions developed. The integrals are tabulated to four significant places for the arguments x = = 0(.1)1(.2)2(.5)10(1)20 at half-integer spacings of the order p.

A.

517.6 : 537.311.33

844. THE INTEGRALS $\mathfrak{C}_p(x) = (p!)^{-1}\int_0^\infty \epsilon^p(\epsilon^2 + x^2)^{-1}e^{-\epsilon}d\epsilon$ AND $\mathfrak{D}_p(x) = (p!)^{-1}\int_0^\infty \epsilon^p(\epsilon^2 + x^2)^{-2}e^{-\epsilon}d\epsilon$ AND THEIR TABULATION.

R.B.Dingle, D.Arndt and S.K.Roy.
Appl. sci. Res. B, Vol. 6, No. 3, 155-64 (1956).

These integrals are fundamental to the theory of the properties of weakly-degenerate elemental semiconductors when conditions are such that ionic scattering is of comparable importance to scattering by thermal agitation and neutral impurities. Their applications and properties are discussed, and various expansions and relationships to other functions developed. The integrals are tabulated to four significant figures for the arguments x = 0(.1)1(.2)2(.5)10(1)20 at half-integer spacings of the order p.

A.

517.6 : 537.311.33

845. THE INTEGRALS $\mathfrak{E}_p(x) = (p!)^{-1}\int_0^\infty \epsilon^p(1 + x\epsilon^3)^{-1}e^{-\epsilon}d\epsilon$ AND $\mathfrak{F}_p(x) = (p!)^{-1}\int_0^\infty \epsilon^p(1 + x\epsilon^3)^{-2}e^{-\epsilon}d\epsilon$ AND THEIR TABULATION.

R.B.Dingle, D.Arndt and S.K.Roy.
Appl. sci. Res. B, Vol. 6, No. 4, 245-52 (1958).

These integrals are fundamental to the theory of the properties of weakly degenerate semiconductors at high frequencies and/or in the presence of a steady uniform magnetic field, when conditions are such that ionic scattering predominates over scattering by thermal agitation or by neutral impurities. Their applications and properties are discussed, and various expansions and relationships to other functions developed. The integrals are tabulated for arguments x = 0(.002).01, .02(.02).1(.1)1(.2)2(.5)5(1)10(2)20 at half-integer spacings of the order p.

A.

517.6 : 530.162

846. THE FERMI–DIRAC INTEGRALS

$$\mathfrak{F}_p(\eta) = (p!)^{-1}\int_0^\infty \epsilon^p(e^{\epsilon-\eta} + 1)^{-1}d\epsilon.$$

R.B.Dingle.
Appl. sci. Res. B, Vol. 6, No. 4, 225-39 (1957).

Following a discussion of the relationship of the Fermi–Dirac integrals to other functions, complete expansions are developed which enable the integrals of all orders to be calculated without recourse to numerical integration. In order to supplement existing tables, values are given for orders - 1 and 0 for positive and negative arguments, and for orders 1, 2, 3, 4 for positive arguments.

A.

517.6 : 530.162

847. THE BOSE–EINSTEIN INTEGRALS

$$\mathfrak{B}_p(\eta) = (p!)^{-1}\int_0^\infty \epsilon^p(e^{\epsilon-\eta} - 1)^{-1}d\epsilon.$$

R.B.Dingle.
Appl. sci. Res. B, Vol. 6, No. 4, 240-4 (1957).

Following a discussion of the relationship of the Bose–Einstein integrals to other functions, complete expansions are developed which enable the integrals of all orders to be calculated without recourse to numerical integration.

A.

ASTRONOMY . ASTROPHYSICS . GEODESY

522.615 : 535.33.07

848. A PHOTOELECTRIC STELLAR SPECTROPHOTOMETER, USING A FABRY–PEROT ETALON. J.E.Geake and W.L.Wilcock.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 4, 380-3 (1957).

Tests are described of a photoelectric method of investigating stellar spectra, in which a prism monochromator and a Fabry–Perot etalon are used to scan the spectrum simultaneously. The addition of the etalon enables the monochromator to be used with a wider entrance slit for a given wavelength resolution. The etalon is tilted in order to scan in wavelength: this method is simple, but leads to a loss of wavelength resolution which is assessed quantitatively.

A.

523.11 : 531.51 : 532.22

FORMATION OF NEBULAE FROM ISOTHERMAL GAS SPHERES. See Abstr. 908

523.164 : 621.396.677

849. AN INTERFEROMETER FOR RADIO ASTRONOMY WITH A SINGLE-LOBED RADIATION PATTERN.
A.E.Covington and N.W.Broten.
I.R.E. Trans Antennas and Propagation, Vol. AP-5, No. 3, 247-55 (July, 1957).

The configuration used gives a twofold increase in E–W resolving power over a uniformly collecting aperture of equal dimension and it produces a fan-shaped beam. It has been used to obtain daily drift curves of the sun.

A.

523.164.32 : 522.6

850. RADIO PICTURES OF THE SUN.
W.N.Christiansen, D.S.Mathewson and J.L.Pawsey.
Nature (London), Vol. 180, 944-6 (Nov. 9, 1957).

The realization of a radioheliograph (combining the principles of the grating interferometer and the Mills cross) which promises regular pictures of the lower solar corona from its 21 cm wavelength emission is described, and some typical pictures are presented together with Hα spectroheliograms for comparison. The radioheliograph consists of two rows each of 32 19-ft-diameter equatorially-mounted paraboloids, spaced 40 ft apart. A single scan of the sun takes about half an hour. M.W.Ovenden

523.164.4 : 550.38 : 551.510.535

851. THE CORRELATION OF RADIO-STAR-SCINTILLATION PHENOMENA WITH GEOMAGNETIC DISTURBANCES AND THE MECHANISM OF MOTION OF THE IONOSPHERIC IRREGULARITIES IN THE F-REGION. M.Dagg.
J. atmos. terrest. Phys., Vol. 10, No. 4, 194-203 (1957).

The paper describes an experimental investigation of the relation between the phenomena of scintillations of the radio stars and geomagnetic disturbances. A close correlation is found between the magnitude of the variations in the earth's magnetic field and F-region drift velocities as determined by the radio-star scintillation method. There is also occasional correlation between the amplitude of the scintillations and the magnetic variations. These results and those concerned with the reversals in drift directions are shown to be in agreement with the predictions of Martyn's theory (Abstr. 1894/1954, 5773/1955), which ascribes the F-region phenomena to the interaction of the earth's magnetic field with an electric field communicated from the dynamo region. A.

523.164.4 : 550.38 : 551.510.535

852. DIURNAL VARIATIONS OF RADIO-STAR SCINTILLATIONS, SPREAD F, AND GEOMAGNETIC ACTIVITY. M.Dagg.
J. atmos. terrest. Phys., Vol. 10, No. 4, 204-14 (1957).

An equipment has been constructed to enable a long-term investigation to be made of the temporal variations of radio star-scintillations. A year's observations are presented in terms of the monthly average diurnal variations of scintillations which are compared with monthly average diurnal variations of spread F and geomagnetic activity. A.

523.164.42

853. THE RADIO SOURCE IN THE DIRECTION OF THE GALACTIC CENTRE. F.G.Smith, P.A.O'Brien and J.E.Baldwin.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 3, 282-7 (1956).

Measurements have been made over a range of frequencies from 38 to 500 Mc/s of the flux density of radio waves from the intense source in Sagittarius. Aerials with high resolving power in the East–West direction were used, giving a strip distribution of brightness across the source. It was found that the flux density increases with decreasing frequency in this range of frequencies, and that the brightness temperatures exceed those expected from H II regions. The suggestion is now put forward that there is in this direction a non-thermal source of radio-waves lying behind ionized hydrogen, and it is shown that this might account for the unusual spectrum indicated by the available measurements of flux density, including those at high frequencies. The source itself may be similar to other non-thermal galactic radio sources, and its position suggests that it might lie in the galactic nucleus. A.

523.164.83 : 538.566.3 : 551.510.535

854. IONOSPHERIC STUDIES BY THE LUNAR RADAR TECHNIQUE. B.C.Blevis.
Nature (London), Vol. 180, 138-9 (July 20, 1957).

Brief details are given of apparatus which has been set up at Ottawa for the observation of moon-echoes on a frequency of 488 Mc/s. Specimen recordings are reproduced, but no detailed results are presented. G.M.Brown

523.164.83 : 621.396.8

855. THE SCATTERING OF RADIO WAVES BY THE MOON.
J.V.Evans.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1105-12 (Dec., 1957).

A detailed investigation has been made of the rapid fading of radio echoes from the moon on a frequency of 120 Mc/s. This has shown that the conclusion reached in an earlier paper that the moon behaves as a uniformly bright reflector is in need of revision, and that metre length radiowaves are reflected from the moon, largely by a region at the centre of the visible disk which has a radius of about one third of the moon. This result is supported by an investigation of the shape of the received echo using a receiver bandwidth 500 c/s and transmitter pulses of 10 and 2 msec. No lengthening of the transmitted pulse could be detected, indicating that the depth of the scattering region cannot be greater than about 1 msec. Range measurements show that the echo is returned from the front edge of the moon. The effective scattering area of a moon reflecting in this manner has been calculated, and the theoretical and observed signal to noise ratios are now in good agreement, indicating that the power reflection coefficient of the lunar surface is 0.1. The effect of this type of scattering on a moon relay communications system is briefly discussed. A.

523.322 : 535.361.2

COMPARISON OF THE LAW OF REFLECTION OF LIGHT FOR THE MOON AND FOR CERTAIN KINDS OF ROCKS. See Abstr.583

523.5 : 523.164.85

856. THE VARIATION OF IONIZATION ALONG A METEOR TRAIL. J.S.Greenhow and E.L.Neufeld.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 4, 359-69 (1957).

The ionized trails of faint meteors have been investigated by observation of radio-echoes at two spaced receiving stations. The mean ionization curve is much shorter than predicted by present theory, and in particular the rise to maximum electron line density is more rapid than expected. Occasional meteors appear almost instantaneously with maximum electron density, and in many cases irregularities in the ionization considerably distort the diffraction effects during trail formation. Evidence for the fragmentation of meteors is also presented. These effects are considered in relation to Jacchia's photographic observations of the light curves of faint visual meteors. A.

523.74 : 532.5 : 538.3

857. SOLAR ATMOSPHERIC HEATING BY HYDROMAGNETIC WAVES. J.H.Piddington.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 3, 314-23 (1956).

Previous estimates of solar atmospheric heating by hydromagnetic waves (due to Joule loss and viscosity) showed negligible heating. A new mechanism is described, involving neutral atoms, which leads to absorption (and heating) many orders of magnitude greater than previously believed. If hydromagnetic waves are present they must cause strong heating effects. The formation of such waves from granules is described, their absorption at low levels, and partial reflection being discussed in some detail. A very rough order-of-magnitude estimate of energy flow is obtained. The region in which heating effects are important is restricted to the transition zone between lightly ionized and fully ionized gas. The energy absorbed in this region is estimated as being $\sim 10^5$ erg.cm^{-2}.sec^{-1}. Numerous particles with energies ~ 100 eV are released in this region and these may account for the quiet (non-spot) corona. The mechanism is likely to be important in connection with sunspot heating and flares and perhaps also interstellar hydromagnetic waves and cosmic ray generation. A.

523.752 : 523.875

858. TEMPERATURES AND ELECTRON DENSITIES IN FLARES AS DERIVED FROM SPECTROSCOPIC DATA.
J.T.Jefferies.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 5, 493-504 (1957).

It is shown that model flares with electron concentrations and temperatures in the ranges $5 \times 10^{11} - 10^{13}$ cm^{-3} and $10^4 - 1.5 \times 10^{4.0}$K respectively have emissions consistent with the observed hydrogen and helium line intensities in solar flare spectra. Some difficulties are shown to exist in interpreting the observed great line-width of Hα and a possible solution is given. A.

523.755

859. MAGNETOHYDRODYNAMIC SHOCK WAVES IN THE SOLAR CORONA, WITH APPLICATIONS TO BURSTS OF RADIO-FREQUENCY RADIATION. K.C.Westfold.
Phil. Mag. (Eighth Ser.), Vol. 2, 1287-302 (Nov., 1957).

It is pointed out that the Type II burst velocities which are usually associated with the velocities of streams of "auroral" particles should rather be associated with the velocities of the shock fronts ahead of such streams. Likewise, the far greater Type III burst velocities can be associated with the shock velocities of corpuscular streams having similar velocities, if it is possible to raise the local value of the sound velocity to the magnitude of the Type III estimates. This can be effected if local magnetic fields of some hundreds of gauss are present in the solar corona, resulting in a predominant magnetohydrodynamic component in the sound velocity. Starting from a set of transport equations previously investigated for an ionized gas, it is shown that in quasi-static electromagnetic fields the coronal medium satisfies an adiabatic

equation of state and that the magnetic field lines are effectively "frozen" into the medium. The details of the transition across the shock front ahead of a stream in which all physical quantities depend only on the coordinate in the direction of flow is investigated for the case where the stream velocity is small compared with the sound velocity, and the results are compared with those for the hydrodynamic shock associated with a Type II burst. The coronal conditions and the excitation of radiation near the shock front are briefly discussed. A.

523.77

860. SOME OBSERVATIONS OF THE INFRARED SOLAR SPECTRUM FROM A HIGH-FLYING AIRCRAFT.
J.T.Houghton, T.S.Moss, J.S.Seeley and T.D.F.Hawkins.
Nature (London), Vol. 180, 1187-8 (Nov. 30, 1957).

Using an infrared grating spectrometer (resolution ~ 2 cm^{-1}) and a PbS detector installed in a Canberra aircraft, observations were made of the 1.9 μ water-vapour absorption band at altitudes of 20 000 and 45 000 ft. The results indicate that the water vapour in a vertical column of atmosphere above 45 000 ft is equivalent to a path of laboratory air containing ~5μ of precipitable water.
D.R.Barber

523.873

861. SYNTHESIS OF THE ELEMENTS IN STARS.
E.M.Burbidge, G.R.Burbidge, W.A.Fowler and F.Hoyle.
Rev. mod. Phys., Vol. 29, No. 4, 547-650 (Oct., 1957).

523.875

862. FINITE ATMOSPHERES WITH ISOTROPIC SCATTERING. II. INCREASE OF LINE STRENGTH TO THE LIMB; III. CORRIGENDUM AND ADDENDUM. I.W.Busbridge.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 3, 304-13 (1956); Vol. 117, No. 5, 516-20 (1957).

For Pt I see Abstr. 52 (1957). The following problem in the theory of the formation of absorption lines is solved by the method developed in Pt I: An atmosphere of finite thickness lies above a photosphere of infinite extent, both being stratified in plane parallel layers. The absorption lines are formed by coherent isotropic scattering in the atmosphere, and there is continuous emission according to a linear Planck function throughout both photosphere and atmosphere. It is required to find the emergent intensity at any point of the line profile. Subject to certain assumptions, the exact solution is found in terms of the X- and Y-functions and their moments. Some numerical results are obtained and a theory is put forward to account for the variations in the intensities of faint and strong lines across the solar disk. A.

PHYSICS

53.081

863. SECULAR CHANGES OF THE UNITS AND CONSTANTS OF PHYSICS. A.H.Cook.
Nature (London), Vol. 180, 1194-5 (Nov. 30, 1957).

It is argued that absolute changes in physical quantities are indetectable experimentally and that only changes in ratios of quantities are measurable. The bearing of this argument on the choice of basic units is discussed and it is pointed out that secular changes in non-dimensional ratios do have physical significance.
A.H.Cook

FUNDAMENTALS

530.12

864. THE GRAVITON AND GRAVITATION IN THE FUNCTIONAL THEORY OF CORPUSCLES. J.L.Destouches.
C.R. Acad. Sci. (Paris), Vol. 245, No. 18, 1518-20 (Oct. 28, 1957).
In French.

A theory of a corpuscle of maximum spin 2 is outlined, which includes gravitation and electromagnetism. R.J.N.Phillips

530.12 : 532.5

865. INTRODUCTION OF EINSTEIN–KRAMERS AND CAYLEY–KLEIN RELATIVISTIC PARAMETERS IN THE RELATIVISTIC THEORY OF FLUIDS WITH INTERNAL SPIN.
B.C.Unal and J.P.Vigier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 21, 1785-8 (Nov. 18, 1957).
In French.

Orthonormal tetrads moving with each fluid element define 4-vector velocity and spin, and are used to establish the equivalence of 4-vector and spinor formulations of the theory. R.A.Newing

530.12 : 532.5

866. INTRODUCTION OF EINSTEIN–KRAMERS AND CAYLEY–KLEIN RELATIVISTIC PARAMETERS IN THE RELATIVISTIC HYDRODYNAMICS OF WEYSSENHOFF'S FLUID WITH SPIN. B.C.Unal and J.P.Vigier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1890-2 (Nov. 25, 1957).
In French.

The Lagrangian for the fluid is expressed in terms of the E.K. tetrads; the transition to spinor formulation introduces expressions used by Takabayasi for the Dirac fluid. R.A.Newing

530.12

867. THE CLOCK PARADOX IN RELATIVITY.
C.G.Darwin; H.Dingle.
Nature (London), Vol. 180, 976-7 (Nov. 9); 1275-6 (Dec. 7, 1957).

A leaves B and subsequently rejoins B by means of rocket propulsion, the two observers emitting signals at uniform rates. Darwin uses a definite numerical illustration to verify asymmetric ageing, the outward and return journeys being of equal duration for A but not for B. Dingle, for whom symmetry is axiomatic, considers that A and B make equal estimates of the time taken in the outward journey, and that this time is for each of them the same fraction of the total time of separation. R.A.Newing

530.12

868. THE CLOCK PARADOX OF RELATIVITY. L.Essen.
Nature (London), Vol. 180, 1061-2 (Nov. 16, 1957).

A distinction is drawn between the time standard S supplying regular impulses and the clock dial counting them. It is asserted that time dilation is an effect obtained when impulses received from S_B are recorded on a dial moving with A and compared with a local clock at A; the effect is symmetrical with respect to the moving observers A and B. R.A.Newing

530.12

869. SPHERICALLY SYMMETRIC SOLUTION OF THE EQUATIONS OF GENERAL RELATIVITY WHEN THE ENERGY-MOMENTUM TENSOR IS THAT OF THE BORN–INFELD ELECTROMAGNETIC THEORY. J.Lameau.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2208-10 (Dec. 16, 1957).
In French.

The solution obtained for the non-static case is shown to be the same as that for the static case. R.A.Newing

530.12

870. GRAVITATIONAL FIELDS AND QUANTUM MECHANICS.
T.Regge.
Nuovo Cimento, Vol. 7, No. 2, 215-21 (Jan. 16, 1958).

Several kinds of measurements of gravitational fields are qualitatively discussed. It is shown that no one of them yields satisfactory results if the region in which the field is measured has linear dimensions smaller than $L = Gh/c^2$. A.

530.12

871. RADIATION DAMPING IN GENERAL RELATIVITY.
P.Havas.
Phys. Rev., Vol. 108, No. 5, 1351-2 (Dec. 1, 1957).

Lorentz invariant equations of motion are derived from a power series approximation method for a system of N simple poles in a gravitational field. It is found that gravitational radiation damping terms occur with the same form as the electromagnetic damping terms, and it is suggested therefore that gravitational radiation effects have as much reality as electromagnetic effects.
G.Stephenson

530.145

872. PARAMETRIC REPRESENTATIONS OF GENERAL GREEN'S FUNCTIONS. Y.Nambu.
Nuovo Cimento, Vol. 6, No. 5, 1064-83 (Nov., 1957).

Parametric representations for the Green's function of field

theory are derived in perturbation theory. These representations are valid for each term in the perturbation series that corresponds to a Feynman diagram, and reflect its analytic property and threshold characteristics. As an example, the three-body (vertex) function is shown to satisfy a dispersion relation when two of the three momenta are fixed, with the correct location of the singularities expected from the thresholds of the competing real processes. A.

530.145

873. ON THE QUANTIZATION OF TENSOR FIELDS WITH ZERO MASS. C.G.Bollini.
Nuovo Cimento, Vol. 6, No. 5, 1034-9 (Nov., 1957).

A general formulation of quantum field theory for massless tensor fields, compatible with the supplementary conditions, is given. The free field (or the interacting field in the interaction representation) is expressed in terms of its components "along" the transversal polarization tensors defined in the text. These components are taken as canonical coordinates, on which the canonical commutation relations are imposed. The corresponding commutation relations of the field components are given. A.

530.145

874. FIELD OPERATORS AND RETARDED FUNCTIONS. V.Glaser, H.Lehmann and W.Zimmermann.
Nuovo Cimento, Vol. 6, No. 5, 1122-8 (Nov., 1957).

A formula for the expansion of field operators with respect to products of ingoing fields is derived. The coefficients in this expansion are the retarded functions introduced earlier. They fulfil a system of equations which turns out to be not only a necessary, but also sufficient condition for such functions to yield a local field operator. A.

530.145

875. HILBERT SPACES IN QUANTUM FIELD THEORIES. S.Albertoni and F.Duimio.
Nuovo Cimento, Vol. 6, No. 5, 1193-205 (Nov., 1957).

The structure of the Hilbert space spanned by the states of a quantized field is examined. A hypothesis is made concerning the possibility of a physical interpretation of various subspaces of it, and connections with some "pathological" results derived by several authors, are indicated. A.

530.145

876. ON THE RUIJGROK–VAN HOVE MODEL. G.Dell'Antonio and F.Duimio.
Nuovo Cimento, Vol. 6, No. 3, 751-4 (Sept., 1957).

The Ruijgrok–van Hove model (Abstr. 8377/1957) is a generalization of the Lee model and also of fixed source neutral scalar meson theory. The conditions on the coupling constants and the cut-off necessary to exclude "ghost" states are determined.

J.C.Taylor

530.145

877. NON-LOCAL SEPARABLE INTERACTIONS AND THE SCATTERING MATRIX. K.Chadan.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1597-8 (Nov. 4, 1957). In French.

It is shown how a separable potential, with central and tensor parts, can be found from a knowledge of the eigen-S phase-shift and a certain mixture coefficient as functions of energy. The number of solutions in various circumstances is studied. R.J.N.Phillips

530.145

878. ON GAUGE INVARIANCE OF SECOND KIND. B.Ferretti.
Nuovo Cimento, Vol. 6, No. 4, 997-8 (Oct., 1957).

A proof is given that gauge invariance of the second kind is a necessary, as well as a sufficient condition for a local current conservation law, $\partial j_\mu/\partial x_\mu = 0$, for a fermion current j_μ.

G.H.Burkhardt

530.145 : 539.12

879. NON CONSERVATION OF PARITY AND THE UNIVERSAL FERMI INTERACTION. J.Tiomno.
Nuovo Cimento, Vol. 6, No. 4, 912-16 (Oct., 1957).

A universal Fermi interaction of the form S + P + T is proposed, in which there are two kinds of two-component neutrino, of opposite helicity, one occurring with electrons, the other (usually) with muons. If experiment should show that positrons from the $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ decay chain are right-handed, then this theory would be disproved.

J.C.Taylor

530.145

880. RENORMALIZATION OF A PARITY NON-CONSERVING THEORY. B.d'Espagnat and J.Prentki.
Nuovo Cimento, Vol. 6, No. 5, 1129-34 (Nov., 1957). In French.

The extension of the renormalization procedure to a parity non-conserving theory is investigated. For the sake of definiteness a parity non-conserving interaction term is assumed, which means that a parity non-conserving (but CP invariant) nucleon–hyperon–K interaction is postulated: CP invariance is introduced so that the α/β ratio of terms with opposite parities could eventually be appreciable without violating known experimental data (absence of electric dipole moment for elementary particles). It is shown that the theory represented is indeed renormalizable. In the proposed renormalization procedure a real physical nucleon has still a definite parity with respect to the bare nucleon. Effects of parity non-conservation are then entirely contained in the renormalized vertex operators $\Gamma_r^{\pm}$ as well as in the renormalized barion propagation function $(S_r(p)$, which, however, tends to the same limiting form as the usual $S_r(p)$ of a parity conserving theory in the limit where p tends towards the four momentum of a real particle. It is considered that such a renormalization scheme is necessary if quantitative estimation of the maximum admissible α/β ratio compatible with experimental data is desired. A.

530.145

881. RENORMALIZABLE THEORY FOR FERMI INTERACTIONS. Y.Tanikawa.
Phys. Rev., Vol. 108, No. 6, 1615-19 (Dec. 15, 1957).

A possible model for renormalizable Fermi interactions is discussed. In this theory, Fermi interactions are replaced by indirect two-stage processes which are transmitted by some Bose fields with zero spin having only renormalizable interactions with Fermi particles. A.

530.145

882. ADDITIONAL REMARKS AND ERRATA CORRIGE TO A PAPER ON THE THEORY OF SPIN 2 PARTICLES. T.Regge.
Nuovo Cimento, Vol. 6, No. 5, 1233-4 (Nov., 1957).

See Abstr. 7594 (1957).

530.145

883. CERTAIN PROPERTIES OF THE SOLUTIONS OF THE EQUATION OF CHEW AND LOW. M.Froissart and R.Omnès.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2203-6 (Dec. 16, 1957). In French.

Analytic properties of the solutions of the Chew–Low equation are studied for symmetric pseudoscalar mesons with static source. In particular the Riemann surface of these functions is completely determined and is shown to possess an infinite number of sheets.

S.F.Edwards

530.145

884. DISPERSION RELATIONS FOR FERMIONS. Riazuddin.
Nuovo Cimento, Vol. 6, No. 6, 1252-67 (Dec., 1957).

Generalized dispersion relations for scattering of 2 fermions are derived in a way similar to that used for fermion–boson scattering. The 2-nucleon problem is discussed in particular. The relations are written for functions which can be expressed in terms of the phase shifts. A.

530.145

885. THEORIES OF COLLECTIVE BEHAVIOUR. D.ter Haar.
Rep. Progr. Phys., Vol. 20, 130-62 (1957).

A general discussion of the problems raised by systems of many interacting particles is given. General methods are discussed for dealing with these problems, and special attention is paid to the method developed by Tomonaga. This method is applied to the theories of sound waves, plasma oscillations in electric discharges, nuclear surface modes, and liquid helium. A brief discussion is also given of some aspects of spin waves used in ferromagnetism and antiferromagnetism. A.

530.145

886. EXPLICIT POTENTIALS FOR GIVEN SCATTERING FUNCTIONS OF CHARGED PARTICLES WITH ABSORPTION. W.R.Theis.
Z. Naturforsch., Vol. 11a, No. 11, 889-91 (Nov., 1956). In German.

Potentials are found for scattering functions which are the product of that for the pure Coulomb field with a rational function of the wave-number. This includes possible absorption, i.e. complex potentials. W.A.Hepner

530.145 : 539.12

APPROXIMATE METHODS IN S WAVE PION NUCLEON SCATTERING. See Abstr. 700

530.145

887. THE REPRESENTATION OF SYSTEMS OF PARTICLES IN THE CAUSAL INTERPRETATION OF WAVE MECHANICS, AND THE NATURE OF THE QUANTUM POTENTIAL. J.Andrade e Silva.
C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1893-5 (Nov. 25, 1957). In French.

The theory proposed by de Broglie and the author (Abstr. 3979/

1957) is further discussed. Difficulties which arise when external potentials are present suggest that a modification of the fundamental equations is needed. P.M.Davidson

530.145

888. APPLICATIONS OF A HIGH-ENERGY COULOMB WAVE FUNCTION. R.E.Prange and R.H.Pratt.
Phys. Rev., Vol. 108, No. 1, 139-43 (Oct. 1, 1957).

The well-known approximate Coulomb wave-function, which is essentially the asymptotic form of the exact wave-function, is shown to be valid in the computation of certain high-energy, small-angle processes. In an explicit calculation of the atomic photoelectric effect, the result of Hall is obtained in a somewhat more convenient form. Approximations to this result are discussed and the limiting case $Ze^2/\hbar c = 1$ is evaluated. For bremsstrahlung and pair production, it is found that the wave-function is not completely adequate, although still useful. The Coulomb scattering cross-section may also be computed if sufficient care is exercised. A.

530.145

889. CONSTRUCTION OF S^2 EIGENFUNCTIONS BY THE METHOD OF SPIN OPERATORS. I. GENERAL THEORY. F.Berencz and R.Pauncz.
Proc. Phys. Soc., Vol. 71, Pt. 2, 145-51 (Feb., 1958).

A general spin operator, a function of the so-called step-up and step-down operators, is suggested which when operating on the eigenfunctions of the total S_z operator related to maximal, minimal and zero projections of the total spin creates each eigenfunction of the total S^2 corresponding to its different eigenvalues. A.

530.145

890. CONSTRUCTION OF S^2 EIGENFUNCTIONS BY THE METHOD OF SPIN OPERATORS. II. SIX-ELECTRON SYSTEMS. F.Berencz.
Proc. Phys. Soc., Vol. 71, Pt 2, 152-60 (Feb., 1958).

In Pt I of this paper (see preceding abstract) a spin operator was introduced which when operating on the eigenfunctions of the total S_z operator related to maximal, minimal and zero protections of total spin creates each eigenfunction of the total S^2 corresponding to its different eigenvalues. In this second part a brief discussion of the proposed operator technique developed for the problem of six-electron system is presented. A.

530.145

891. PROBLEM OF PERTURBED BOUNDARY CONDITION IN QUANTUM MECHANICS. S.Sen Gupta and H.Mukhopadhyay.
Proc. Phys. Soc., Vol. 71, Pt 2, 173-6 (Feb., 1958).

Problem of perturbed boundary condition is reduced to an equivalent problem of perturbation potential with the introduction of a deformed coordinate system. The method is applied to determine the energy of a nucleon in a rigid ellipsoidal box. A.

530.145 : 539.2

SPACE-GROUP OPERATIONS AND TIME-REVERSAL FOR A DIRAC ELECTRON IN A CRYSTAL FIELD. See Abstr. 808

530.16 : 621.391 : 061

892. A BIBLIOGRAPHY OF INFORMATION THEORY (COMMUNICATION THEORY—CYBERNETICS). SECOND SUPPLEMENT. F.L.H.M.Stumpers.
I.R.E. Trans Inform. Theory, Vol. IT-3, No. 2, 150-66 (June, 1957).

For previous supplement, see Abstr. 1530B (1956), I.R.E. Trans Inform. Theory, Vol. IT-1, No. 2, 31-44 (Sept., 1955). A classified bibliography covering: 1. General theory; 2. (a) Bandwidth and transmission capacity, time-frequency uncertainty (b) Signal-to-noise ratio; (c) Instantaneous frequency (d) Analytical signals; 3. Definition, relation with statistical mechanics, philosphy; 4. Correlation prediction, filtering, storage; 5. (a) Radar (b) Radio-navigation; 6. (a) Speech (b) Hearing (c) Vision (d) Linguistics, semantics; 7. (a) Other biological applications (Cybernetics and the nervous system) (b) Human engineering (c) Group communication and learning; 8. Television; 9. (a) Miscellaneous applications (b) Games (c) Optics (d) Servomechanisms; 10. Mathematics: (a) Statistics (b) Games (theory) (c) Relay-algebra, reliability (d) Noise analysis; 11. Pulse modulation, multiplex, coding.

530.162

893. A GENERAL TREATMENT OF EXPANDING SYSTEMS. I. FORMULATION. Y.Takahashi and H.Umezawa.
Nuovo Cimento, Vol. 6, No. 6, 1324-34 (Dec., 1957).

A general method of handling an expanding system is proposed from the field theoretical view point. It is shown that the canonical variables of a system S[V] enclosed in a volume V are connected by a unitary transformation with the canonical variables of a system S[V'] in a larger volume V'. The unitary transformation connecting these two systems is generated by the difference of the respective Hamiltonians. A.

530.162 : 539.12

894. A GENERAL TREATMENT OF EXPANDING SYSTEMS. II. APPLICATION TO MULTIPLE MESON PROCESSES. Y.Takahashi and H.Umezawa.
Nuovo Cimento, Vol. 6, No. 6, 1382-91 (Dec., 1957).

The general theory proposed in the Pt I (preceding abstract) is applied to multiple meson processes. This is a field theoretical justification of the Landau theory of multiple meson production, based on a hydrodynamical analogy. According to calculation, mesons enclosed in a narrow disk will expand in the direction perpendicular to the disk and give a sharp angular distribution in agreement with recent experimental data. A.

530.162 : 517.6

THE FERMI–DIRAC INTEGRALS. See Abstr. 846

530.162 : 517.6

BOSE–EINSTEIN INTEGRALS. See Abstr. 847

GENERAL MECHANICS. MECHANICS OF SOLIDS

531.25 : 535.55

895. CONTACT STRESSES IN TOROIDS UNDER RADIAL LOADS. H.Fessler and E.Ollerton.
Brit. J. appl. Phys., Vol. 8, No. 10, 387-93 (Oct., 1957).

The investigation was restricted to the measurement and calculation of shear stresses only, since these are considered the most important. The stresses were determined using the frozen stress photoelastic technique. A large range of toroids, with positive, zero and negative surface curvatures was tested. The shapes and sizes of the contact areas were in close agreement with Hertzian theory, and the values and positions of the maximum shear stresses agreed with calculated values based on the analysis by Thomas and Hoersch. It was found that for many practical cases of rolling contact the maximum range of the orthogonal shear stress exceeds the maximum shear stress. This is because the orthogonal shear stress is reversed as one body rolls over the other. A method of calculating the greatest range of orthogonal shear stress has been developed from Hertz's theory. The measured stress ranges and their positions agreed with the calculated values. A.

531.25

896. SUMMARIZED PROCEEDINGS OF THE ELEVENTH ANNUAL CONFERENCE OF THE STRESS ANALYSIS GROUP — LEICESTER, APRIL 1957. A.F.C.Brown.
Brit. J. appl. Phys., Vol. 8, No. 12, 467-70 (Dec., 1957).

A conference of the Stress Analysis Group of the Institute of Physics at which fifteen papers were discussed. These covered the established methods of stress analysis and some newer developments as well. Among them were three papers on fundamentals and the examination of stresses and strains on a microscopic scale. Two of these were on metals whilst the third was on rubber. A.

531.258 : 517.924.9

897. SOME FURTHER RESULTS ON THE RUBBER MEMBRANE THEORY AND LAPLACE'S EQUATION. W.Fulop.
J. sci. Instrum., Vol. 34, No. 11, 453-4 (Nov., 1957).

Some further results and points are presented to underline the theory of constant horizontal tension of the rubber membrane as discussed in a previous paper by the author (Abstr. 1560/1955). Small deflection theory which assumes constant resultant tension fails, in the case of coaxial geometry, to account at large deflections for (a) the linear force-deflection law obtained and (b) the close correspondence of the membrane's contour to Laplace's equation. Both observations are successfully predicted by the revised theory which places no limitations on geometry or deflection for the above two conditions to hold. Experiment also confirmed a linear force-deflection law for an asymmetric geometry. A.

MECHANICAL MEASUREMENTS

531.787 : 621.317.39

898. A NEW METHOD OF MEASURING RAPIDLY VARYING HIGH PRESSURES. G.Landwehr and K.F.Zobel.
Z. InstrumKde, Vol. 65, No. 11, 220-3 (Nov., 1957). In German.

The transducer described makes use of the anisotropic piezo-resistive effect in n-type germanium. It is shown that the resistance change increases linearly with pressure. The effect of temperature changes is compensated by a second germanium crystal which is connected in series with the transducer crystal in a potentiometer circuit. K.W.Plessner

MECHANICS OF FLUIDS

532.133 : 532.14 : 537.311.35

899. PHYSICAL PROPERTIES OF CERTAIN LIQUID BINARY ALLOYS OF TIN AND ZINC. T.C.Toye and E.R.Jones. APPENDIX: THE DETERMINATION OF VISCOSITY. D.G.B.Thomas.
Proc. Phys. Soc., Vol. 71, Pt 1, 88-97, 97-9 (Jan., 1958).

The viscosity, density and specific resistance of a number of tin-based and zinc-based binary alloys have been determined over various temperature ranges starting at a few degrees above the liquidus and extrapolated back to the melting point. The variation of these properties with increasing alloy additions has been found to be non-linear and minima have been observed near eutectics and limits of solid solubility. The paper gives the results of these measurements on Zn–Al, Zn–Pb, Zn–Sn, Sn–Zn, Sn–Ag, Sn–Cu, Sn–Ni and Sn–Pb systems. A.

532.5.031

900. THE CALCULATION OF THE DRAG IN PROBLEMS SOLVED BY THE HODOGRAPH METHOD. A.G.Mackie.
Phil. Mag. (Eighth Ser.), Vol. 3, 140-2 (Feb., 1958).

Explicit formulae are found for the total drag on a class of obstacles placed in a uniform stream of an inviscid fluid when the stream function is given in terms of the velocity variables. The formulae are given for incompressible flow and for the exact equation of compressible flow. A.

532.522

901. VISCOUS FLOW BETWEEN ROTATING CYLINDERS AND A SHEET MOVING BETWEEN THEM. M.R.Hopkins.
Brit. J. appl. Phys., Vol. 8, No. 11, 442-4 (Nov., 1957).

The motion of a sheet, emerging from a liquid and passing between a pair of cylindrical rollers, is considered. An expression for the thickness of the liquid layer finally left on the sheet is derived in terms of the viscosity of the liquid, the size of the rollers, the speed at which the sheet moves through them and the force with which they are pressed together. A.

532.574

902. THE LEON TUBE: AN INSTRUMENT FOR MEASURING FLOW SPEEDS IN WATER. J.F.Kemp.
J. sci. Instrum., Vol. 34, No. 10, 390-2 (Oct., 1957).

A description is given of the construction and performance characteristics of an instrument which is capable of measuring flow speeds in water "at a point" over a range of 1 to 14 ft/sec. The accuracy at 1 ft/sec is approximately $1\frac{1}{2}\%$ and improves rapidly with increasing speed. The Leon tube is of robust and compact construction and is, in effect, a combination of a differential pressure tube and a differential liquid manometer. The pressure factor of the tube, which is a function of Reynolds number, is most readily determined in a wind tunnel. The instrument has proved to be particularly suitable for the performance of velocity traverses in open channels. A.

MOLECULAR THEORY OF LIQUIDS

532.7

903. ON THE EQUATION OF STATE OF GASES AND LIQUIDS. D.Milosavliévitch.
C.R. Acad. Sci. (Paris), Vol. 245, No. 13, 1050-1 (Sept. 23, 1957). In French.

An experimentally verified form convenient for both is described. P.Gray

532.7 : 535.43 : 537.531

904. SMALL ANGLE X-RAY SCATTERING FROM SOLUTIONS OF ALKALI METALS IN LIQUID AMMONIA. P.W.Schmidt.
J. chem. Phys., Vol. 27, No. 1, 23-8 (July, 1957).

The small-angle X-ray scattering from solutions of lithium, sodium, and potassium in liquid ammonia was measured using molybdenum K radiation. Scattering curves were obtained for a series of concentrations of lithium solutions at -75°C, for one concentration at -45°C and -75°C, for potassium, sodium, and lithium solutions of approximately the same molarity, and for lithium and sodium solutions near saturation. The scattering data indicate the presence of scattering centres of dimensions of the order of 15 A, with at most a few types of centres in a given solution, and with the type of centre depending on the metal ion. There was no evidence for the simultaneous presence of cavities with diameters of the order of 8 A. Calculations indicate these cavities probably would have been observed if present. These results are in good qualitative agreement with the theory of Becker, Lindquist, and Alder. The "hole theory" developed by Lipscomb and by Kaplan and Kittel would require modification to account for the observed scattering. A.

532.73 : 541.135

905. IMPROVED APPROXIMATION FOR THE POTENTIAL OF SPHERICAL POLYELECTROLYTE MOLECULES IN SOLUTION. S.Lifson.
J. chem. Phys., Vol. 27, No. 3, 700-1 (Sept., 1957).

An improved approximate solution of the Poisson–Boltzmann equation for spherical polyelectrolytes is suggested. It is compared with the results of a numerical solution of the same equation by Wall and Berkowitz, as well as with an approximation proposed by Osawa, Imai, and Kagawa. A.

532.77

906. NONIDEALITY OF LIQUID ORTHO–PARAHYDROGEN SOLUTIONS. H.L.Friedman.
J. chem. Phys., Vol. 27, No. 1, 220-3 (July, 1957).

The thermodynamic properties are calculated from the total pressure measurements of Woolley, Scott and Brickwedde (Abstr. 1440/1949) by a method which is applicable to systems in which the fugacity coefficients of the vapours are independent of composition at given T and P, and in which the liquid solution obeys the law, $G^{ex}/x(1-x)$ = constant. For ortho–parahydrogen solutions at 20^{0}K, $H^{ex} = 3.07x(1-x)$ cal/mole and $S^{ex} = 0.097x(1-x)$ cal/mole.deg. The asymmetry of the pair-wise intermolecular potentials noted by Woolley, Scott and Brickwedde is confirmed. A.

MECHANICS OF GASES

533.15 : 539.18

907. THE BEHAVIOUR OF SULPHUR DIOXIDE IN THE SEPARATION TUBE. K.Clusius and H.U.Hostettler.
Z. Naturforsch., Vol. 12a, No. 1, 83-4 (Jan., 1957). In German.

From experiments performed at 0.73 atm. in a separation column 10 m long, 0.85 cm diameter with a hot wire of Pt-Ir 0.04 cm dia. the authors estimate that a thermal diffusion factor α equal to 0.53×10^{-3} can be obtained, and that a plant of length 75 m should yield 80% S^{34} for a power consumption of 7.2 kW. Wallkopf (Abstr. 1531/1957) estimated 180 m and 15 kW for the same yield. The possibility of using thermal diffusion in a two phase system consisting of liquid and gaseous sulphur dioxide is also considered. H.C.Cole

533.22 : 531.51 : 523.11

908. BOYLE'S LAW AND GRAVITATIONAL INSTABILITY. W.B.Bonnor.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 3, 351-9 (1956).

A modified form of Boyle's law is derived for a spherical mass of gas at uniform temperature in equilibrium under its own gravitation and an external pressure, and a typical p–V curve is shown. Any such mass of gas is gravitationally unstable if sufficiently compressed. It is shown also that a sufficiently large isothermal gas sphere is unstable, and the condition for this is compared with Jeans' formula for gravitational instability. The relevance of the phenomenon to the formation of the nebulae is briefly considered. A.

533.56

909. ON THE MEASUREMENT OF SPEED OF A VACUUM PUMP. N.A.Florescu.
Appl. sci. Res. B, Vol. 7, No. 1, 63-72 (1958).

After pointing out the drawbacks of the conventional procedures of pumping speed measurement, an improved procedure is described

in which the admitted gas is uniformly distributed over a cross-section of a tube of the same size as the pump casing. The pressure is measured above this section, where the gas is in a static state. The actual as well as the intrinsic speed of the pump can accurately be determined. As the speed factor for indicating the pumping efficiency the ratio of these speeds is suggested. The intrinsic speed is a function of the intake pressure. The highest value of this speed was found to be 65% of the conductance of a well-designed pump. These results do not agree with the conclusions of the diffusion theory. Correction of the Langmuir formula suggested previously by the writer is confirmed. A.

533.59

910. HIGH VACUUM SHAFT SEALS, FLANGED JOINTS AND THE GASSING AND THE PERMEABILITY OF RUBBER-LIKE MATERIALS. R.H.V.M.Dawton.
Brit. J. appl. Phys., Vol. 8, No. 10, 414-21 (Oct., 1957).

Various designs of high vacuum shaft seals are given and their performance measured by the pressure rate of rise in a closed system. Experiments show that there is little to choose between them from their vacuum performance, although the washer in which a tension spring is embedded is at times to be prefered. A large portion of the leak is condensable indicating something more complicated than the direct passage of air through the seal. Experiments give measurements of the gassing from rubber-like materials including neoprene and butyl rubber when totally enclosed in a vacuum system, and also measurements of their permeability to gases. All the synthetic materials tested gassed considerably more than did rubber. In the permeability experiments it was found that the time required for gases to pass through diaphragms varies from several minutes to an hour, depending on the gas. The permeability, unlike the gassing effect, is considerably less than with the synthetic rubbers tested than with rubber. Data are given of the testing of flanged gasket joints and their effect on a vacuum system during the first twenty hours of pumping when the joint gassing is liable to be confused with a leak. Data are also given on the flange clamping pressure necessary for a tight joint. A.

533.6.011.311

911. BOUNDARY LAYER GROWTH ON A SPINNING BODY: ACCELERATED MOTION. Y.D.Wa/lhwa.
Phil. Mag. (Eighth Ser.), Vol. 3, 152-8 (Feb., 1958).

The motion in the boundary layer when a body of revolution is started to move along its axis of symmetry and simultaneously to rotate about it with a velocity varying as the nth power of time, is investigated. The corresponding problem for an impulsive start was tackled by Illingworth (Abstr. 1110/1954). It is found that the separation is delayed by acceleration. Also, the time that elapses before separation first takes place is lessened by increasing the velocity of spin. A.

533.6.08

912. A SENSITIVE AERODYNAMIC DRAG BALANCE AS AN INDICATOR OF LOW AIR SPEEDS. J.F.Kemp.
J. sci. Instrum., Vol. 34, No. 10, 411-15 (Oct., 1957).

The construction and performance characteristics of a low air-speed indicator, which can be used as standard of comparison for the routine calibration of anemometers in a wind tunnel, are described. The apparatus is essentially a very sensitive drag balance in which the forces acting on a disk are utilized to determine the air speeds. The effective range is from 0.2 to 16 ft/sec, and the indicator conforms to all the requirements that may be imposed on a standard of its type. A.

MOLECULAR THEORY OF GASES

533.7 : 530.162 : 539.12

913. RELATIVISTIC CORRECTION TO THE MAXWELL DISTRIBUTION. A.V.Tulub.
Vestnik Leningrad. Univ., Ser. Fiz. Khim., 1957, No. 10, 65-7. In Russian with summary in English.

The relativistic correction to the Maxwell distribution for a perfect Fermi gas is calculated using the equation for the statistical matrix. It is shown that the negative energy states must have negative values of temperature in the Dirac theory of the positron. C.R.S.Manders

533.7

914. THERMODYNAMIC PROPERTIES OF THE GASEOUS ALKALI HALIDES. S.A.Rice and W.Klemperer.
J. chem. Phys., Vol. 27, No. 3, 643-5 (Sept., 1957).

The thermodynamic properties of the alkali halides in the gas phase have been computed for the temperature range 298.16°K to 2000°K. These data are applied to the determination of the dimer concentration in the gas. It is concluded that there is very little dimer and/or higher polymer in the gas, in agreement with previous infrared spectroscopic studies. A.

533.74

915. THE EQUATION OF STATE OF A GAS OF ELASTIC SPHERES. H.N.V.Temperley.
Proc. Phys. Soc., Vol. 71, Pt 2, 238-46 (Feb., 1958).

A study is made of the "Gaussian" model of an imperfect gas used by Ford, which assumes the Mayer function $\exp(-\epsilon/kT)-1$ to be a Gaussian function of the interatomic distance and is, at any fixed temperature, practically equivalent to an elastic sphere model though it could not give the temperature variation of the virial coefficients. The problem is shown to be closely related to one of "restricted random-walk" type, which can be solved almost completely, the combinatorial problems being similar to those of circuit theory. It is concluded that the virial series is analytic for all positive V and that the high-order virial coefficients probably alternate in sign, though this limiting behaviour may well be approached very slowly, because of various "small number effects" that influence the early terms. The model is not directly comparable with that of rigid spheres, because it can be compressed to zero volume. A.

VIBRATIONS. ACOUSTICS

534.01

916. PROGRESSIVE PLANE WAVES IN A CONTINUOUS MEDIUM. J.Kieffer and J.Dapoigny.
J. Phys. Radium, Vol. 18, No. 5, 359-60 (May, 1957). In French.

Using a simple diagrammatic presentation, the progressive-wave systems that are possible in a continuous medium are derived and their properties defined. H.J.H.Starks

534.112

917. NON-LINEAR FORCED VIBRATION OF A STRETCHED STRING. E.W.Lee.
Brit. J. appl. Phys., Vol. 8, No. 10, 411-13 (Oct., 1957).

A stretched string clamped at both ends and driven transversely at the centre is found to undergo non-linear oscillations. Discontinuities in the amplitude of the vibration are observed as the driving frequency is changed (jump phenomena) and the frequency at which these jumps occur depends markedly on whether the frequency is being increased or decreased (hysteresis). The behaviour is in qualitative agreement with simple theory. A.

534.13

918. THE DAMPING EFFECT OF SURROUNDING GASES ON A CYLINDER IN LONGITUDINAL OSCILLATION.
M.T.Browne and J.R.Pattison.
Brit. J. appl. Phys., Vol. 8, No. 11, 452-6 (Nov., 1957).

The external damping influences on a longitudinally vibrating cylindrical bar are examined quantitatively. Experiments undertaken to confirm the theoretical estimations indicate a possible precision method for the determination of gas viscosities. A.

534.2

919. ELASTIC WAVES IN A CONTINUOUSLY STRATIFIED MEDIUM. H.Jeffreys.
Monthly Not. Roy. Astron. Soc., Geophys. Suppl., Vol. 7, No. 6, 332-7 (Nov., 1957).

Approximate methods are applied to problems of internal reflection in a continuous medium when the changes of properties in a wavelength are small. It is found that total internal reflection gives a phase-shift of $\pi/2$ in harmonic waves and hence a blunting of a pulse and the introduction of some oscillation. In the absence of a free surface P and SV movements are substantially independent even if total reflection takes place. SH and SV can travel in an internal layer of low velocity, but will not produce much motion at a free surface unless the total variation of properties is small. P waves in such a channel will suffer attenuation by conversion to SV at the free surface. A.

534.2

920. ELASTIC WAVE PROPAGATION IN A SEMI-INFINITE SOLID MEDIUM. J.W.C.Sherwood.
Proc. Phys. Soc., Vol. 71, Pt 2, 207-19 (Feb., 1958).

A simple physical picture is given of plane waves possessing complex angles of propagation, which play an important role in the theory of elastic wave radiation. Their utility is illustrated by studying continuous sinusoidal wave propagation parallel to the unstressed, plane boundary of a semi-infinite, homogeneous and isotropic solid medium, the Rayleigh and head waves being particular features of the investigation. A novel study of the field due to an impulsive force acting at a line in the surface of a semi-infinite medium indicates a general method of solving important transient propagation problems encountered in seismology. The equivalent problem of an impulsive force acting at the edge and in the plane of a semi-infinite thin sheet has been simulated experimentally by detonating small explosive charges at the edge of an aluminium sheet. The displacements detected by a condenser microphone technique are in excellent agreement with the theoretical determinations. A.

534.22.07

921. AN ULTRASONIC DEVICE FOR MEASURING CERTAIN PHYSICO-MECHANICAL PROPERTIES OF LEATHER, RUBBER, PLASTICS AND HIGH-MOLECULAR-WEIGHT MATERIALS. B.G.Novitskiĭ and V.M.Fridman.
Akust. Zh., Vol. 3, No. 1, 92-4 (1957). In Russian.

Describes apparatus for measuring velocity of sound in materials available in thin sheet form. It consists of four parts. In one unit conventional electronic circuits produce square pulses of 1 μsec duration at a recurrence frequency of 2.5 kc/s. This unit houses also cathode-ray-tube recording gear. The pulses pass to a barium titanate oscillator/transmitter at the bottom of a tea-cup-shaped metal vessel, closed with sheet rubber and filled with liquid to cause the rubber to bulge. The receiver unit is of like construction with the receiving element of L-cut Rochelle salt. The transmitter and receiver units are carried on short pivoted atms attached to a horizontal U-shaped metal frame. C.R.S.Manders

534.222.2

922. EFFECT OF TUBE DIAMETER ON THE PRESSURES IN GASEOUS DETONATION WAVES. D.H.Edwards and G.T.Williams.
Nature (London), Vol. 180, 1117 (Nov. 23, 1957).

Static pressure–time curves are shown for plane detonation waves in a stoichiometric $2H_2 + O_2$ mixture in tubes of 10, 3.8 and 1.6 cm diameter. The pressures in the two wider tubes agree with the theoretical values but that in the narrowest tube drops rapidly from its peak value and oscillates about a low value. The period of oscillation and other data from mixtures of different acoustic velocities suggest that energy is abstracted from the detonation wave through the formation of rarefaction waves at the wall of the tube. H.J.H.Starks

534.222.2 : 537.525

PRODUCTION OF HIGH-ENERGY PLASMAS BY SHOCK WAVES. See Abstr. 630

534.23.08 : 539.19

923. A METHOD FOR DERIVING THE ACOUSTIC ABSORPTION COEFFICIENT OF GASES FROM MEASUREMENT OF THE DECAY-TIME OF A RESONATOR.
P.D.Edmonds and J.Lamb.
Proc. Phys. Soc., Vol. 71, Pt 1, 17-32 (Jan., 1958).

A unique result for the absorption coefficient is obtained from calculations based on measurement of the decay-time using longitudinal and radial modes of propagation. Expressions are given for the losses in the viscous and thermal boundary layers at the walls of the resonator. The method is applicable in the range of frequency divided by pressure of 1 to 45 kc/s per atmosphere. Calibration measurements have been made using argon and nitrogen; the relaxational contribution to the absorption has been evaluated in the case of cyclopropane. A.

534.231

924. CALCULATION OF THE ACOUSTIC FIELD IN THE FOCAL REGION OF A CYLINDRICAL FOCUSING SYSTEM.
I.N.Kanevskiĭ and L.D.Rozenberg.
Akust. Zh., Vol. 3, No. 1, 46-61 (1957). In Russian.

A theoretical paper, sequel to Abstr. 4935/1956. For wavelengths small compared with frequency, the calculation is given for the focal-region acoustic field for infinite and finite wavefronts. In the focal plane,in a direction perpendicular to the axis of the front, the potential shows repeated zeros, whereas in a direction perpendicular to this in the axial plane the potential has minima not falling to zero. C.R.S.Manders

534.232

925. ULTRASONIC BARIUM TITANATE RADIATOR OF HIGH INTENSITY. I.N.Kogan and L.I.Menes.
Akust. Zh., Vol. 3, No. 1, 62-4 (1957). In Russian.

The paper describes construction of a radiator with a reflector consisting of a thin air layer. A layer of the order of 0.01 mm in thickness forms an excellent reflector, and, being thin, does not represent any significant thermal resistance. C.R.S.Manders

534.232

926. THE EFFICIENCY OF ULTRASONIC FOCUSING RADIATORS. L.D.Rozenberg.
Akust. Zh., Vol. 3, No. 1, 94-6 (1957). In Russian.

In their work "Sonics" (New York, 1955, pp. 269-70) Hueter and Bolt developed some ideas for calculating the acoustic radiation flux produced by spherical focusing radiators intended for treating liquids flowing through the focal region of such radiators. Besides the more obvious parameters such as diameter of the reflector, focal length etc., which are involved in an expected fashion, Hueter and Bolt found that acoustic flux varies as λ^3. Rozenberg points out that the dependence of the amplification factor of a focusing radiator on frequency has been overlooked by the above authors. A recalculation by Rozenberg shows that efficiency at the focal spot is proportional to λ. C.R.S.Manders

534.343 : 539.19

INFRARED SPECTRA OF MONOMERIC FORMIC ACID. See Abstr. 793

534.39 : 532.528

927. THE PROBLEM OF CAVITATIONAL DAMAGE OF SOLIDS. A.S.Bebchuk.
Akust. Zh., Vol. 3. No. 1, 90-1 (1957). In Russian.

Specimens of sheet aluminium were set up in a holder over 8 kc/s transducer and the "damage" measured by the loss in weight of the specimen. Experiments were performed at various temperatures and in various liquids, e.g. water, alcohol, paraffin, benzene, acetone. A curve is given for loss of weight v. time for specimens immersed in liquids at 15°C. Rate of loss is greatest in water. A second curve shows weight stripped in a fixed time v. temperature for various liquids. Characteristic peaks are observed, that for water occurring at about 50° C. C.R.S.Manders

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.784

928. PHONETOGRAPH AND SUBFORMANTS. J.Dreyfus-Graf.
Tech. Mitt. P.T.T., Vol. 35, No. 2, 41-59 (1957). In French.

An outline of apparatus used in the recognition and phonetic representation of speech. Oscillograms are included to show that, in addition to the well-known formants, a major part of the characterization, especially of sounds such as plosive consonants, depends upon subformants in the range 0-60 c/s, derived by Fourier analysis of the speech envelope. A similar analysis of the subformants yields sub-subformants, occupying the range 0-30 c/s, and providing additional characterization. A short account of the history and possible applications, including phonetic typewriters and reduced-bandwidth transmission systems, and a block diagram of the analysing circuits are given. T.H.D.Attewell

534.844.5

929. CORRELATION CRITERION OF REVERBERATION OPTIMUM. V.V.Furduev.
Akust. Zh., Vol. 3, No. 1, 74-80 (1957). In Russian.

The paper discusses factors determining reverberation optima for auditoria and their variation with the nature of acoustic signals. It is suggested that the current autocorrelation interval of a signal is the basic determining factor and deductions arising from this are compared with experimental data. C.R.S.Manders

534.852 : 621.395.625.3 : 621.317.39

930. PULSE METHOD OF MEASURING TAPE SPEED FLUCTUATION. A.G.Al'mukhamedov.
Akust. Zh., Vol. 3, No. 1, 19-22 (1957). In Russian.

A tape passes between the apertures of a recording and reproducing head. Pulses are recorded and reproduced with a delay equal to the distance between the two heads divided by the tape speed. The time intervals between these two events are measured by a cathode-ray oscilloscope and variations readily observed. C.R.S.Manders

OPTICS. RADIATION. SPECTRA

535.12 : 535.41 : 621.391

931. RECIPROCITY INEQUALITIES, COHERENCE TIME AND BANDWIDTH IN SIGNAL ANALYSIS AND OPTICS. E.Wolf.
Proc. Phys. Soc., Vol. 71, Pt 2, 257-69 (Feb., 1958).

This paper is concerned with establishing a rigorous reciprocity relation of the Heisenberg type between the coherence time and the bandwidth of polychromatic radiation. Following upon an observation of Gabor (J. Instn Elect. Engrs, Pt III, Vol. 93, 429-57, Nov., 1946) that the usual formulation of the reciprocity inequality which relates the effective duration of a signal and its effective bandwidth is unsatisfactory for signals that are intrinsically real (e.g. an electric signal), a modified version is here presented. The present analysis is closely related to that of Gabor and supplements it in several respects. In particular it is shown that Gabor's formulation, like the present one, is restricted to signals with zero mean value. Contrary to general belief, there is no evidence that the inequality holds when this restriction is removed. A definition of the coherence time of light is then proposed in terms of the (measurable) correlation function that plays a central part in the theory of partial coherence. The coherence time obeys rigorously a reciprocity inequality of the required type and is shown to have a simple interpretation in terms of averages involving the correlations in fluctuations of the instantaneous intensity. It is also shown that the coherence time may be determined experimentally from Michelson's visibility curve of interference fringes. A.

535.13

932. OPTICS OF ABSORBING CRYSTALS. I. GENERAL RELATIONS. F.I.Fedorov.
Optika i Spektrosk., Vol. 2, No. 5, 616-22 (1957). In Russian.

Equations for the Maxwell field in an anisotropic absorbing medium are set up in their most general form, which includes as particular cases both plane and circular polarization. The invariance and normalization relations are discussed in some detail.
J.W.Gardner

535.13

933. THE OPTICS OF ABSORBING CRYSTALS. II. CRYSTALS OF MEDIUM SYNGONIES. F.I.Fedorov.
Optika i Spektrosk., Vol. 2, No. 6, 775-80 (1957). In Russian.

Theoretical paper. Trigonal, tetragonal and hexagonal crystals have axes of symmetry of higher order than the second and this simplifies considerably the relationships of general invariant theory set out in Pt I (see preceding abstract). General equations are obtained for the refraction vector and field vectors of the ordinary and extraordinary rays of homogeneous and nonhomogeneous waves. It is shown that the absorbing and corresponding transparent crystals differ specifically in that the former can exhibit absence of double refraction for a whole range of directions of incident light.
C.R.S.Manders

535.14

934. TIME-CORRELATED PHOTONS.
G.A.Rebka, Jr and R.V.Pound.
Nature (London), Vol. 180, 1035-6 (Nov. 16, 1957).

The time correlation of photons is coherent light-beams is investigated, using pulse and coincidence techniques.
P.M.Davidson

535.241.41 : 536.33

935. A FLUX THEOREM. D.J.Hofsommer.
Appl. sci. Res. B, Vol. 6, No. 6, 446-8 (1957).

In the literature some formulae are known which give the total flux incident on an area originating from a surface source. These formulae are derived again by aid of a flux theorem which transforms the original double surface integral into a double line integral over the boundaries of both areas. A.

535.247.4

936. ATTACHMENT TO THE A.E.G. ILLUMINATION PHOTOMETER FOR BRIGHTNESS MEASUREMENTS.
H.Buchbinder and G.Eckhardt.
Lichttechnik, Vol. 9, No. 11, 550-1 (Nov., 1957). In German.

Describes two attachments to the A.E.G. photoelectric photometer by means of which (a) the luminance of an extended illuminated surface and (b) that of a source of light may respectively be measured. J.W.T.Walsh

535.3

937. APPARATUS FOR OPTICAL STUDIES TO VERY HIGH PRESSURES. R.A.Fitch, T.E.Slykhouse and H.G.Drickamer.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1015-17 (Nov., 1957).

An apparatus has been developed in two stages which permits optical studies to 200 000 atm pressure. The use of NaCl windows permits studies in the near ultraviolet and in the infrared as well as in the visible. The design of the pressure cells and of a press suitable to fit in a spectrometer are described with essential dimensions. A calibration tested against Bridgman's data to 87 000 atm is given.
A.

535.3 : 536.48

938. TECHNIQUE FOR OPTICAL MEASUREMENT AT LIQUID NITROGEN TEMPERATURE. E.J.West.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1034 (Nov., 1957).

Optical measurements made on samples immersed in liquid nitrogen usually suffer from poor signal-to-noise ratios arising from bubbling within the liquid nitrogen and consequent irregular changes in the light transmission. It is reported that a constant flow of helium, hydrogen or neon gas directed upon the surface of the boiling liquid nitrogen completely eliminates the bubbling.
E.A.Mussett

535.317

939. ON THE ERROR BALANCING OF AN OPTICAL SYSTEM IN COMBINATION WITH ITS RECEIVER. K.Miyamoto.
J. Opt. Soc. Amer., Vol. 47, No. 9, 774-9 (Sept., 1957).

The problem of how the aberration of a lens should be balanced is studied in order to get the best result in combination with its receiver (photographic emulsion, television pick-up tube, etc.) The intensity distribution of light in the line image formed by the lens is assumed to be expressed approximately by the sum of two error functions corresponding to the image core and halo, respectively, and the diffusing characteristics of the light receiver are represented by a third error function. A formula is deduced which expresses the resultant response of the total system (lens plus receiver) with parameters used in the three error functions described above. As a measure of the over-all image quality of the total system the maximum value in the resultant response (S.D.) — the generalized Strehl definition — is chosen. This method is applied to the error balancing of a lens having primary and secondary spherical aberration, the intensity distribution being obtained by spot diagrams. As a result, the over-corrected type is better when the receiver has a small degree of diffusion, and the under-corrected type is preferred when it has a large one. A.

535.317.1

940. GEOMETRICAL OPTICAL CALCULATION OF FREQUENCY RESPONSE FOR SYSTEMS WITH SPHERICAL ABERRATION.
N.S.Bromilow.
Proc. Phys. Soc., Vol. 71, Pt 2, 231-7 (Feb., 1958).

The usefulness of the geometrical-optical treatment of frequency response is considered. With this treatment calculations have been made, using numerical integration, for several cases of defect of focus, primary and secondary spherical aberration. The results are compared with those obtained from diffraction treatments of the same cases. Provided the wave-front aberration exceeds about 1 wavelength, it appears that geometrical optics will give an accuracy in the calculated frequency response of about 5% of its value for zero frequency, over the range of frequencies encountered in many photographic objectives. A.

535.317.6

941. CONTROL OF RESIDUAL ABERRATIONS IN THE DESIGN OF ANASTIGMAT OBJECTIVES. W.J.Smith.
J. Opt. Soc. Amer., Vol. 48, No. 2, 98-105 (Feb., 1958).

A systematic investigation is made of the effect of the parameters not required to control the seven Seidel aberrations on the residual zonal aberrations in a four element anastigmat of the Dogmar or Celor type. A correlation between the vertex length of the system and the residual spherical and angular coverage is established. The effect of the Petzval sum and power balance on these residuals is also investigated. A survey of published designs is presented which indicates that these correlations are quite general in their application to most anastigmats. Four basic principles relating these residual aberrations with lens construction are given as an aid to systematic lens design. A.

535.317.6

942. GEOMETRICAL-OPTICAL TREATMENT OF FREQUENCY RESPONSE. H.H.Hopkins.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1162-72 (Dec., 1957).

An expression is obtained for the frequency response of an optical system according to the approximation of geometrical optics. The difficulties inherent in the explicit calculation of ray densities in the image are avoided. The method is applied to defect of focus, astigmatism and aberration tolerances, and the results compared with those obtained according to diffraction theory. In the cases studied the ray-optically calculated frequency response suggests a poorer image quality than that given by diffraction theory. A.

535.322.4 : 535.399

943. REFLECTION OF LIGHT FROM ABSORBING LIQUIDS. T.I.Gracheva.
Optika i Spektrosk., Vol. 2, No. 6, 792-9 (1957). In Russian.

It is widely believed that total-reflection refractometers may be used for absorbing liquids as well as for transparent ones and the Abbé instrument is adapted for measurements in both. The theoretical part of this paper attempts to determine the limits of applicability of total-reflection instruments in the case of absorbing liquids. In the experimental part it is found that the reflection coefficient of a liquid is only affected to any extent near the critical angle and for smaller angles the effect of absorption is negligible.
C.R.S.Manders

535.323.08 : 535.345.08

944. A NEW METHOD OF DETERMINATION OF OPTICAL CONSTANTS. N.N.Pribytkova.
Optika i Spektrosk., Vol. 2, No. 5, 623-7 (1957). In Russian.

Based on the method by Kravets et al. (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 12, 504, 1948), whereby the refractive index and absorption coefficient are found from reflection measurements, the constants for crystalline and amorphous selenium over the 3500-6500 A region have been determined on a Beckmann spectrophotometer. L.Bovey

535.329 : 537.525

945. AN APPARATUS FOR OBSERVATION OF ANOMALOUS DISPERSION IN PROCESSES OF SHORT DURATION. A.M.Shukhtin and V.S.Egorov.
Optika i Spektrosk., Vol. 2, No. 4, 543-4 (1957). In Russian.

D.S.Rozhdestvenskii's "hook" method (Anomalous Dispersion, published by the Academy of Sciences of U.S.S.R., 1951) of observation of anomalous dispersion requires exposures from several seconds to several minutes. To study transient processes (e.g. pulse discharges, shock waves, wire explosions etc.) the present authors used the "hook" method with a strong light-source of the pulse type (a discharge tube which produced a very bright continuous spectrum from 6500 to 2200 A). This source was used to study pulse discharges in neon (at several mm of Hg) of about 300 μsec duration.
S.Chomet

535.33.07

946. VACUUM EBERT GRATING SPECTROMETER. W.G.Fastie, H.M.Crosswhite and P.Gloersen.
J. Opt. Soc. Amer., Vol. 48, No. 2, 106-11 (Feb., 1958).

A new scanning spectrometer is described which is based almost exclusively on very recent technological advances and which, over the ultraviolet, visible, and near infrared region to 6 microns is capable of resolution and wavelength measuring accuracy comparable, on a wave-number basis, with the best that has been accomplished with spectrographs limited to the photographic region. The instrument is of the Ebert type and employs gratings as large as 5 × 7 inches, has a focal length of 72 inches, uses circularly curved slits 2 inches long, and can be triple passed. Specifications and performance are outlined. A.

535.33.07 : 534.232

947. ON THE RELATIONSHIP BETWEEN THE SPECIFIC AND THRESHOLD SENSITIVITIES OF THE CHAMBER OF A SELECTIVE OPTICO-ACOUSTIC RECEIVER AND ITS TIME CONSTANT. N.A.Pankratov.
Optika i Spektrosk., Vol. 2, No. 5, 662-6 (1957). In Russian.

There is an exhaustive discussion of the problem of the excitation of acoustic oscillations in the chamber of a selective receiver and the relationship mentioned in the title is shown. The time constant is of interest, because it is easy to determine experimentally. The author discusses the magnitude of gas-pressure pulsations in the chamber, the natural noises and threshold sensitivity of the chamber of a selective receiver. C.R.S.Manders

535.33.07

948. A NEW PRINCIPLE IN SPECTROMETRY. N.G.Bakhshiev.
Optika i Spektrosk., Vol. 2, No. 6, 816-18 (1957). In Russian.

This note gives the principle of an apparatus proposed for analysis of weak sources, e.g. photoelectric recording of photoelectric or Raman spectra. The usual dispersing elements, e.g. prism or grating are not required. The idea is that the radiation is amplitude-modulated at frequencies which are monotonic functions of wavelength over the whole spectral range. The modulator consists of two crystal wedges which form a plane-parallel plate of variable thickness, the optic axes of the wedges being parallel to the direction of their displacement. Modulation is effected by interference of the polarized beams of light. A double function is served by the receiver-amplifier viz. monochromatization and recording. C.R.S.Manders

535.331

949. $^5S_2{}^0$ TERM OF NEUTRAL GERMANIUM. K.L.Andrew and K.W.Meissner.
J. Opt. Soc. Amer., Vol. 47, No. 9, 850-2 (Sept., 1957).

The discovery of two new germanium lines at λ 2467.368 A and λ 2416.505 A led to the recognition of the missing $4s4p^3\ ^5S_2{}^0$ term of Ge I. It is situated 41926.726 cm^{-1} above the ground level $4s4p^2\ ^3P_0$ and the lines mentioned above are the combinations $\nu = 4s^24p^2\ ^3P_{2,1} - 4s4p^3\ ^5S_2{}^0$, respectively. A.

535.331 : 539.18

950. TRANSITION PROBABILITIES FOR FORBIDDEN LINES OF Fe III AND Fe V. R.H.Garstang.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 4, 393-405 (1957).

Transition probabilities have been computed for magnetic-dipole and electric-quadrupole radiation for all transitions between levels of the $3d^4$ configuration of Fe V and the $3d^6$ configuration of Fe III. A.

535.332

951. ON THE STARK EFFECT OF THE BALMER LINES EMITTED FROM A HYDROGEN POSITIVE-RAY IN AN INHOMOGENEOUS ELECTRIC FIELD. H.Griem.
Z. Phys., Vol. 148, No. 3, 374-9 (1957). In German.

Some observations are made upon the difference in widths between the short and long wavelength components of the Balmer lines, formed in an inhomogeneous electric field. R.W.Nicholls

535.332

952. EMISSION SPECTRUM OF BROMINE EXCITED IN THE PRESENCE OF ARGON. I. P.Venkateswarlu and R.D.Verma.
Proc. Indian Acad. Sci. A, Vol. 46, No. 4, 251-64 (Oct., 1957).

535.332

953. EMISSION SPECTRUM OF BROMINE EXCITED IN THE PRESENCE OF ARGON. II. THE BAND SYSTEM IN THE REGION 3150-2970 A. P.Venkateswarlu and R.D.Verma.
Proc. Indian Acad. Sci. A., Vol. 46, No. 6, 416-21 (Dec., 1957).

535.333 : 539.19

954. ROTATIONAL ANALYSIS OF BANDS OF THE $c^3\Sigma$, $b^3\Sigma - a^3\Pi$ SYSTEM OF BORON MONOFLUORIDE, BF. R.F.Barrow, D.Premaswarup, J.Winternitz and P.B.Zeeman.
Proc. Phys. Soc., Vol. 71, Pt. 1, 61-4 (Jan., 1958).

Rotational analyses have been made of six bands of the $b^3\Sigma - a^3\Pi$ system and of the 0,0 band of the $c^3\Sigma - a^3\Pi$ system of BF. Contrary to an earlier analysis, appreciable Λ-type doubling is found in the $^3\Pi$ state; its magnitude and sign show that this state is regular and not inverted. No predissociations or interactions with the singlet states have been observed. A.

535.333 : 539.19

955. AlH [ALUMINIUM HYDRIDE] BANDS AT 2173A AND 2101 A. M.Aslam Khan.
Proc. Phys. Soc., Vol. 71, Pt 1, 65-8 (Jan., 1958).

Two new bands of aluminium hydride have been found in the far ultraviolet region of the spectrum at 2173 A and 2101 A. The rotational analysis shows that they are the (1,0) and (0,1) bands of the systems $C^1\Sigma \rightarrow A^1\Sigma$ and $D^1\Sigma \rightarrow A^1\Sigma$ respectively. The (0,1) band at 2101 A shows perturbation as well as predissociation. The rotational constants for the (0,1) band and the (1,0) band are

calculated as follows:

$D^1\Sigma \rightarrow A^1\Sigma$, (0,1) band $\left\{ \begin{array}{ll} B'_v = 6.56\ cm^{-1} & D'_v = 6.1 \times 10^{-4}\ cm^{-1} \\ B''_v = 6.16\ cm^{-1} & D''_v = 3.3 \times 10^{-4}\ cm^{-1} \end{array} \right.$
$\nu_0 = 47\,665.6\ cm^{-1}$

$C^1\Sigma \rightarrow A^1\Sigma$, (1,0) band $\left\{ \begin{array}{ll} B'_v = 5.87\ cm^{-1} & D'_v = 13 \times 10^{-4}\ cm^{-1} \\ B''_v = 6.33\ cm^{-1} & D''_v = 3.2 \times 10^{-4}\ cm^{-1} \end{array} \right.$
$\nu_0 = 45\,922.45\ cm^{-1}$

A.

535.333 : 621.373

956. COHERENT SPONTANEOUS MICROWAVE EMISSION BY PULSED RESONANCE EXCITATION. L.E.Norton.
I.R.E. Trans Microwave Theory and Tech., Vol. MTT-5, No. 4, 262-5 (Oct., 1957).

Describes an investigation of the coherent microwave emission from pulse-excited ammonia molecules. Coherent and periodic pulses of near resonance frequency and 1 μsec duration excited the gas from its initial thermal equilibrium condition. Self-induced coherent emission (molecular ringing) continued after the excitation field was removed. This radiation was observed during a period of 10 μsec. In an actual experiment performed, a new Doppler bandwidth reduction method was used in the gas cell. The observed spectral width of the ammonia 7,7 line was about 5 kc/s. The emission was used to stabilize the excitation signal source to a short-term frequency stability of 2×10^{-10}. A.

535.333

957. NEW FORM OF INFRARED SPECTRA OF SYMMETRICAL MOLECULES AND CRYSTALS. I.B.Bersuker.
Optika i Spektrosk., Vol. 2, No. 5, 671-2 (1957). In Russian.

Discusses the absence of certain terms in the rotational spectra of symmetrical molecules (and crystals). It can be understood by considering the behaviour of the rotational Hamiltonian of a symmetric system under a canonical transformation, and comparing it with that for an asymmetric system under the same transformation. J.W.Gardner

535.338.35 : 535.89 : 537.525

958. PREVENTION OF REVERSAL IN MERCURY-198 LAMPS. K.M.Baird and D.S.Smith.
Nature (London), Vol. 180, 1476 (Dec. 28, 1957).

Self-reversal of the line 5461 A of Hg^{198} can be prevented by using hydrogen or nitrogen instead of argon as the carrier gas in an electrodeless discharge. A.H.Cook

535.34.07

959. IMPROVED OPTICAL NULL INFRARED SPECTROPHOTOMETER. L.W.Herscher, H.D.Ruhl and N.Wright.
J. Opt. Soc. Amer., Vol. 48, No. 1, 36-42 (Jan., 1958).

The design embodies several new features directed toward improved quantitative accuracy of chemical analysis, particularly differential analysis. An arrangement for by-passing a small amount of radiation around the sample cell provides a dynamic balance at zero transmission; a means for automatic gain control during differential recording permits the beam-balancing servo to remain active through absorption bands of the reference material as deep as 95% absorbed; a new type of radiation attenuator is used which permits simpler optical design and provides exact linearity between pen movement and percent transmitted. Other features include improved scan-speed control, expansion of pen-travel in ordinate direction, and use of a nonlinear ($\lambda^{1/2}$) wavelength scale. Differential performance is demonstrated using the difficult example of an impurity of propylbenzene in ethylbenzene. A.

535.34.07

960. MICROWAVE APPARATUS FOR THE MEASUREMENT OF THE REFRACTION, DISPERSION AND ABSORPTION OF GASES AT RELATIVELY HIGH PRESSURE.
A.Battaglia, F.Bruin and A.Gozzini.
Nuovo Cimento, Vol. 7, No. 1, 1-9 (Jan. 1, 1958).

An apparatus of high sensitivity is described using a single frequency-modulated klystron oscillator. The resonance curve of a sample cavity is compared to the one of a reference cavity by means of an electronic device using microsecond pulse technique. Without special precautions the sensitivity for measurements of the power absorption coefficient is $10^{-5}\ m^{-1}$ and 10^{-8} for the refractive index. A.

535.343

961. EMPIRICAL REGULARITIES IN THE SPECTRA OF COMPOUNDS CONTAINING CHROMOPHORIC GROUPS. I. A.Wenzel.
J. chem. Phys., Vol. 27, No. 1, 331-3 (July, 1957).

Empirical regularities have been found in the u.v. spectra of compounds containing chromophoric groups which permit approximate prediction of spectral data for other compounds and may be useful in the identification of emission spectra of chromophoric radicals and certain transient absorption bands. R.C.Seymour

535.343

962. ABSORPTION SPECTRA OF CRYSTALS OF PLUTONIUM SALTS. A.L.Leontovich.
Optika i Spektrosk., Vol. 2, No. 6, 695-703 (1957). In Russian.

The following substances were studied: (1) salts of quadrivalent Pu: sulphate, nitrate, chloride and trichloracetate with $La[PuLa(CCl_3COO)_7]$; (2) trivalent Pu–K sulphate; (3) salts of hexavalent plutonium: plutonyl perchlorate and plutonyl chloride. The method used was that described by Z.M.Sverdlov (Abstr. 193/1951). Measurements were carried out at temperatures from +20° C to −170° C. The results are presented in four figures and three tables. From the results available the author concludes that the interaction of the plutonium ion with its lattice is so strong that crystals of the plutonium salts do not exhibit luminescence. The absorption spectra of Pu salts are attributed to degenerate dipole transitions from the lowest level. Quadrivalent plutonium sulphate has absorption lines whose width depends exponentially on temperature, and its spectrum is very similar to the spectra of rare-earth salts. S.Chomet

535.343 : 541.124

963. ABSORPTION SPECTRA OF FLAT FLAMES USING A MULTIPLE-REFLEXION TECHNIQUE.
G.N.Spokes and A.G.Gaydon.
Nature (London), Vol. 180, 1114-15 (Nov. 23, 1957).

Difficulties of observing absorption spectra of flames are stressed. With a multiple reflection system of aluminized quartz mirrors and a high-pressure xenon arc, absorption by various flames in the ultraviolet has been studied, using up to 24 traverses. For rich flames of ether, hexane, etc., bands of benzene at 2589-2528 A and an unassigned band at 2750 A have been found. This detection of benzene appears to support a ring-closure theory of carbon formation. Formaldehyde bands have also been detected in flames of ether, methanol and acetaldehyde, but are very weak for hexane; this suggests that formation of pyrolysis products is more rapid than oxidation. A.G.Gaydon

535.343

964. OPTICAL ABSORPTION LINES OF HYDRATED MANGANOUS SALTS AT LOW TEMPERATURES. R.Pappalardo.
Phil. Mag. (Eighth Ser.), Vol. 2, 1397-414 (Dec., 1957).

The absorption spectra of four manganous hydrated salts (sulphate, chloride, fluosilicate and ammonium sulphate) were investigated at 78° K and 20° K in the 15 000 cm^{-1} to 30 000 cm^{-1} range. Several groups of lines are found, some of them showing subsplitting of the order of 10 cm^{-1}. The results are satisfactorily interpreted by means of the ligand field theory; a qualitative discussion of refinements of the cubic field scheme in relation to the observed spectra is also given. A.

535.343 : 551.521.6

965. LONG PATH WATER VAPOR SPECTRA WITH PRESSURE BROADENING. I. 20 μ TO 31.7 μ. C.H.Palmer, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1024-8 (Nov., 1957).

This is an experimental study of the meteorologically important 50 μ pure rotation band of water vapour. Transmission through a 196 m path under a range of known conditions of water concentration and of nitrogen pressures was measured. Pt I reports transmission spectra for the region 20 μ to 31.7 μ at a resolution of about 4 cm^{-1}. The water vapour partial pressure ranges from 0.02 to 0.7 cm Hg and the nitrogen partial pressure from 0 to 60 cm Hg. The method for sample analysis is indicated and the importance of adsorption effects demonstrated. A.

535.343 : 551.521.6

966. LONG PATH WATER VAPOR SPECTRA WITH PRESSURE BROADENING. II. 29 μ TO 40 μ. C.H.Palmer, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1028-30 (Nov., 1957).

See preceding abstract. Pt II covers the region 29 μ to 40 μ under the same conditions as nearly as possible. The path length is 196 m and the spectral resolution is about 5 cm^{-1} at 40 μ, the slit

width being fixed as before. The water vapour partial pressure ranges from 0.015 to 0.6 cm Hg and the nitrogen partial pressures from 0 to 60 cm. A.

535.343 : 539.19

967. ON THE STRUCTURE OF ABSORPTION BANDS OF LIQUID H_2O, D_2O AND HDO, DETERMINED BY THEIR MOLECULAR STRUCTURE. M.O.Bulanin.
Optika i Spektrosk., Vol. 2, No. 5, 557-61 (1957). In Russian.

The spectra were examined on an instrument with an LiF prism; the H_2O spectra were also measured on a grating spectrometer. The H_2O and D_2O gave a doublet structure with absorption maxima at 3425, 3290 and 2550, 2435 cm^{-1} respectively. The HDO gave broad bands with maxima at 3420 and 2510 cm^{-1}. The results are used in a discussion on the theoretical structure of these liquids.

L.Bovey

535.343.9 : 535.375.5

968. THE INTENSITIES OF LINES IN RAMAN SPECTRA OF STANDARD SUBSTANCES. V.T.Aleksanyan and Kh.E.Sterin.
Optika i Spektrosk., Vol. 2, No. 5, 562-7 (1957). In Russian.

This paper reports accurate measurements of the Raman spectrum intensities of the standard substances: cyclohexane, methylcyclohexane, toluene and of other substances which can be used as standards: cyclopentane, benzene and carbon tetrachloride. The results are given in 8 tables. S.Chomet

535.343.9 : 535.375.5

969. APPARATUS FOR OBTAINING RAMAN SPECTRA OF GASES. V.I.Tyulin and V.M.Tatevskiĭ.
Optika i Spektrosk., Vol. 2, No. 6, 820-1 (1957). In Russian.

A high-pressure cell in which gases can be contained is described and a short account given of methods used to increase Raman line intensities. A microphotometer trace of the CO_2 doublet (1286 and 1388 cm^{-1}) taken at 3 atm pressure is shown.

L.Bovey

535.343.9 : 535.375.5 : 535.43

970. SCATTERING OF LIGHT IN SOLUTIONS FAR FROM THE ABSORPTION BAND. L.N.Ovander.
Optika i Spektrosk., Vol. 2, No. 6, 781-91 (1957). In Russian.

A mathematical analysis is carried out of the effect of the solvent on the spectral form of scattering lines, on the basis of a concrete model (see Abstr. 7313/1954). Using this model and assuming certain approximations, the author obtains the spectral form of scattering lines for the Raman and incoherent Rayleigh scattering. The coherent part is not affected by the solvent. F.Lachman

535.345 : 535.325

971. ABSORPTION AND REFRACTION OF SOME POLAR GASES AS A FUNCTION OF PRESSURE AT MICROWAVE FREQUENCIES. A.Battaglia, F.Bruin and A.Gozzini.
Nuovo Cimento, Vol. 7, No. 1, 87-94 (Jan. 1, 1958).

Measurements were made at 32 mm wavelength and 0°C. For ammonia, trimethylamine, ammonia–argon and ammonia–hydrogen mixtures a quadratic dependence was found. For OCS and several amines the absorption increases less than quadratically. At the same pressure and concentration, the same absorption was found for ammonia–argon and ammonia–hydrogen mixtures. For absorbing gases, at low pressures, the refractive index is not proportional to the pressure. A.

535.345

972. [CONTRIBUTION TO THE] THEORY OF IMPURITY CENTRES IN ANISOTROPIC HOMOPOLAR CRYSTALS. M.F.Deĭgen.
Optika i Spektrosk., Vol. 2, No. 5, 587-91 (1957). In Russian.

Develops a theory of the optical properties of impurity centres in a homopolar crystal with an anisotropic energy surface of the band electron. The parameters (position of the maximum, magnitude and temperature-dependence of the half-width) of the absorption band of the impurity atom are calculated. Results of calculation are compared with experimental data in the case of Si; an approximate agreement (only in the order of magnitude) is reported.

F.Lachman

535.345.1

973. METHOD FOR THE MEASUREMENT OF TRANSPARENCY OF SHEET MATERIALS. A.C.Webber.
J. Opt. Soc. Amer., Vol. 47, No. 9, 785-9 (Sept., 1957).

Measurements of optical clarity of sheets of plastics and other materials are needed for communication and specification. These are particularly important for materials having such extremes of transparency as films used for packaging and diffusers for lighting fixtures. A method is described for measurement of specular transmittance at essentially 0° angle to the incident beam. Data correlate with observation over nearly five powers of ten for materials from optical glass to nearly perfect diffusers, including commonly used plastics films. A.

535.345.1 : 537.311.33

974. EFFECT OF A STRONG ELECTRIC FIELD ON THE TRANSPARENCY OF A GERMANIUM DIODE.
Yu.I.Ukhanov and S.G.Shul'man.
Zh. tekh. Fiz., Vol. 27, No. 11, 2507-9 (1957). In Russian.

An attempt was made to elucidate the influence of the prerupture states in a p–n junction on the coefficient of absorption of infrared radiation. The junctions were prepared by fusing indium into n-germanium. The width of the light probe was 0.15 mm. Rectangularly pulsed electric current (length of pulses 1-3 msec) was passed through the junction. It was found that the d.c. pulse reduced transparency at all points of the p–n junction.

535.345.6

975. OBLIQUE INTERFERENCE FILTER FOR NONPARALLEL LIGHT. M.J.Irland and V.L.Lindberg.
J. Opt. Soc. Amer., Vol. 47, No. 9, 780-2 (Sept. 1957).

Narrow-band multilayer transmission filters for use in an oblique position were made to exhibit substantially uniform peak transmittance for all rays in a strongly converging beam. The required increase of film thickness with distance from an asymmetrically placed axis can be produced by appropriate baffling. Residual errors of ±3 A are approximately equal to reported random variation in thickness of evaporated films. Filters of 13 layers designed for binocular visual use have shown transmittances above 70% over a field 10° square. A.

535.345.6 : 535.417

976. COMPLEX INTERFERENCE OPTICAL FILTERS WITH IMPROVED CHARACTERISTICS.
K.D.Sinel'nikov, I.N.Shklyarevskiĭ and N.A.Vlasenko.
Optika i Spektrosk., Vol. 2, No. 4, 534-6 (1957). In Russian.

This note describes construction of several types of optical filters and is the continuation of earlier work by Sinel'nikov et al. (Abstr. 8131/1956). $M_1D_1M_2D_2M_3$ filters (M's are reflecting layers and D's dielectric layers) were prepared. D_1 was of barium fluoride and D_2 was a wedge-shaped layer of air between M_2 and M_3. M_1 and M_2 were silver layers, M_3 was a silvered glass plate. The filter was made "consistent" by illumination with white light, observation of the resulting interference pattern via a spectroscope and appropriate adjustment of D_2. No numerical values of the characteristics are given. $M_1D_1M_2D_2M_2D_1M_1$ filters, with D_1 of barium fluoride, D_2 a layer of air, M_1 and M_2 of silver, were also prepared. These filters were similar to those of A.Hermansen (Nature, Vol. 174, 218, July 31, 1954). With reflection coefficients R_1 = 83% and R_2 = 93% for M_1 and M_2 respectively, an overall transmission of 30% was obtained with a pass band (centred on 5000 A) of only 45 A, and "contrast" of about 100 000. A method of preparation of filters, similar to that for Fabry–Perot etalons, is also described. S.Chomet

535.348

977. PLEOCHROIC HALOES AND THE ARTIFICIAL COLORATION OF BIOTITES BY α PARTICLES.
S.Deutsch, P.Kipfer and E.Picciotto.
Nuovo Cimento, Vol. 6, No. 4, 796-810 (Oct., 1957).

Comparison is made of natural haloes with the coloration produced by α-particle bombardment from an intense source. It is found that sensitivity of various biotites to the coloration differs for various samples and this factor must be taken into account when age determinations are made using the optical density of pleochroic haloes. J.Adam

535.37 : 539.2

978. ON THE ENERGY OF THERMAL IONIZATION OF TRAPPING CENTRES IN ALKALI HALIDE PHOSPHORS.
I.A.Parfianovich.
Optika i Spektrosk., Vol. 2, No. 5, 592-8 (1957). In Russian.

Ni was introduced into natural NaCl crystals of high purity by electrolysis at high temperature (4 and 16 p.p.m. Ni at 973 and 1033°K, respectively). Reproducible glow curves were obtained following the production of F-centres by X-rays. The width and position of the main peak on these curves varied with activator concentration and thermal treatment. Thus the corresponding thermal activation energies were 1.72 eV for untreated crystals, and 1.4 and 1.02 eV for those electrolysed at 973 and 1033°K. The first value approached the theoretical one for F-centres in NaCl more closely than those experimentally obtained with crystals grown

from the melt. It was noted that the pre-exponential frequency factor found for untreated crystals ($\sim 6 \times 10^{14}$ sec^{-1}) appeared to exceed any possible lattice oscillation frequency. C.H.L.Goodman

535.37 : 539.2

979. THE STRUCTURE OF ALKALI HALIDE PHOSPHORS AND THE MECHANISM OF PROCESSES OF LUMINESCENCE.
L.M.Shamovskiĭ, A.A.Dunina and Yu.N.Zhvanko.
Optika i Spektrosk., Vol. 2, No. 5, 599-605 (1957). In Russian.

A critical discussion of luminescence in pure and activated materials. Luminescence is ascribed to electron–hole recombination at dislocations following electron absorption at adjacent activator sites. Photochemical effects in various phosphors, and the temperature variation of their electrical conductivity in the "structure sensitive range" appeared to agree with this hypothesis. C.H.L.Goodman

535.37

980. THE FLASH-LIKE BURST OF LUMINESCENCE. 1. ZnS:Ni PHOSPHORS. (I).
N.A.Tolstoĭ, A.M.Tkachuk and N.N.Tkachuk.
Optika i Spektrosk., Vol. 2, No. 6, 759-69 (1957). In Russian.

The red band of the phosphor ZnS:Ni shows the flash outburst effect. The magnitude of the flash depends on the length of the dark interval, t_0, between subsequent stimulations, reaching a maximum for a given t_0 which increases with reduction in temperature. The irradiation of a previously stimulated phosphor by infrared and yellow–orange light influences the development of the capacity to give a flash. A phosphor able to emit a flash possesses a wide band of supplementary (optical) absorption. The kinetics of the blue luminescence band (Zn) is closely connected with those of the red band (Ni). A preliminary discussion of the mechanism of the flash outburst shows that it is connected with the transition of electrons or holes from one localized state ("first localization") to a second ("second localization") state. See also Abstr. 4162 and 4169 (1957). C.H.L.Goodman

535.37 : 535.399

981. ON THE INFLUENCE OF RE-ABSORPTION ON KINETICS OF LUMINESCENCE. A.P.Ivanov.
Optika i Spektrosk., Vol. 2, No. 6, 800-8 (1957). In Russian.

Obtains formulae characterizing the intensity of primary and secondary luminescence as a function of the physico-optical parameters of scattering layers. In the model used certain special cases show the influence of these parameters on kinetics of luminescence in the presence of re-absorption of radiation. W.Bardsley

535.37 : 539.2

982. THE EFFECT OF ASSOCIATION OF ANTHRACENE MOLECULES IN NAPHTHALENE CRYSTALS ON THE LUMINESCENCE SPECTRA. A.N.Faĭdysh.
Optika i Spektrosk., Vol. 2, No. 6, 811-14 (1957). In Russian.

The first part of the paper describes preparation of specimens with concentrations of 0.01, 0.1, 0.5% anthracene. The specimens were excited using a mercury lamp. For the very low concentration of 0.01% it is unlikely there is any association of molecules and thus a "molecular" spectrum is obtained. When specimens with other concentrations are prepared and cooled rapidly almost identical "molecular" spectra are obtained. With slow cooling the luminescence spectra are displaced towards the long-wave end of the spectrum. For intermediate rates of cooling there are intermediate spectrum shifts. C.R.S.Manders

535.37

983. AN INVESTIGATION OF THE PROPERTIES OF PHOSPHORS KI:In AND KI:Ga.
Yu.N.Zhvanko, Z.L.Morgenshtern and L.M.Shamovskiĭ.
Optika i Spektrosk., Vol. 2, No. 6, 821-3 (1957). In Russian.

Single crystals of KI were synthesized containing various concentrations of Tl, In and Ga respectively. The role of Tl as an activator for alkali-halide phosphors has been studied extensively and here KI:Tl was used as a standard for comparison. The emission spectra of the substances under photoexcitation were measured. It was found that In and Ga are just as effective activators as Tl. The spectra to which In and Ga give rise are curves of the same shape as for Tl activation but are displaced towards the long-wave end of the spectrum. C.R.S.Manders

535.371

984. DISCRIMINATION BETWEEN "RADIATIVE" AND "NONRADIATIVE" TRANSFER OF MOLECULAR EXCITATION ENERGY IN LIQUID SYSTEMS. A.Weinreb.
J. chem. Phys., Vol. 27, No. 1, 133-6 (July, 1957).

A method for discriminating between radiative and nonradiative transfer of molecular excitation energy in liquid systems is described. A quenching agent is added, which quenches the transfer process and the competition between quenching and nonradiative transfer is utilized. The method is applied to the system diphenyl oxazole + diphenylhexatriene in toluene. A tentative method for the quantitative evaluation of the part each transfer mechanism plays when both are acting is given, and, qualitative agreement, at least, with the theory of Förster on transfer of energy is obtained. A.

535.371

985. FLUORESCENT LIFETIMES OF RARE EARTH SALTS AND RUBY. G.H.Dieke and L.A.Hall.
J. chem. Phys., Vol. 27, No. 2, 465-7 (Aug., 1957).

The mean lives of the resonance levels of the trivalent ions of Sm, Eu, Gd, Tb, and Dy in pure crystalline compounds were determined by a direct measurement of the decay of the fluorescence. They decrease from a maximum of nearly 0.01 sec for Gd^{+++} to either side to less than 10^{-5} sec for Sm^{+++} and Dy^{+++}. The intensity of the observed fluorescence decreases with the mean life, which except for Gd^{+++} is controlled by interactions of the rare earth ion with the crystal lattice. A.

535.371

986. ON THE DIFFUSION THEORY OF FLUORESCENCE QUENCHING IN SOLUTIONS BY FOREIGN SUBSTANCES.
L.A.Kuznetsova, B.Ya.Sveshnikov and V.I.Shirokov.
Optika i Spektrosk., Vol. 2, No. 5, 578-86 (1957). In Russian.

A theoretical treatment of the effect is given which leads from the requirement of simple non-exponential quenching relationship to a non-proportional change in average lifetime and yield. Confirmation of both the simple quenching relationship and the lifetime and yield changes is shown in experiments on solutions of fluorescein and 3-aminophthalimine. A discussion on the validity of the Perrin–Vavilov law is included. L.Bovey

535.376 : 539.21

987. THE DAMAGE TO PLASTIC SCINTILLATORS BY IONIZING RADIATIONS. I.M.Rozman and K.G.Zimmer (Tsimmer).
Internat.J. appl. Radiation and Isotopes, Vol. 3, No. 1, 36-42 (1958). English translation of article in: Atomnaya Energiya, Vol. 2, No. 1, 54-60 (1957). In Russian.

For abstract see Abstr. 7782 (1957).

535.376

988. THE LIGHT OUTPUT OF ANTHRACENE FOR ELECTRONS OF 20 TO 160 keV. K.W.Hoffmann.
Z. Phys., Vol. 148, No. 3, 303-7 (1957). In German.

An anthracene scintillation counter was used to determine the β-ray spectrum of S^{35} in the energy range 20-167 keV. From the resulting Fermi analysis it is concluded that over this range the anthracene crystal gives a linear response with respect to β-ray energy. G.F.J.Garlick

535.376

989. A SURFACE ELECTROLUMINESCENCE EFFECT IN DIAMONDS. H.J.Logie and R.R.Urlau.
Nature (London), Vol. 180, 1254, 1271 (Dec. 7, 1957).

Type I diamonds having no counting properties, but which had been coated with graphite and annealed, showed green spots of luminescence on the surface when potentials between 30 and 1500 V were applied. The luminescence was independent of polarity and of a wide range of temperature, and was destroyed by surface cleaning. S.T.Henderson

535.376

990. LUMINESCENCE OF ICE IN A STRONG ELECTRIC FIELD. A.V.Astafurov.
Optika i Spektrosk., Vol. 2, No. 4, 540 (1957). In Russian.

A brief note. Specimens, apparently ~6 cm thick, subjected to a > 70 kV pulse of $\sim 3 \times 10^{-7}$ sec duration luminesced for several seconds in the visible and ultraviolet regions with an intensity increasing with decreasing temperature. C.H.L.Goodman

535.39 : 539.23

991. TITANIUM DIOXIDE BEAM SPLITTERS.
L.Holland, T.Putner and S.Batemen.
J. Opt. Soc. Amer., Vol. 47, No. 7, 668-9 (July, 1957).

TiO_2 films produced by heat oxidation of evaporated Ti films on glass are sometimes crazed owing to reaction of Ti with unidentified constituent of glass. Intermediate layers of Al_2O_3, SiO or MgF_2 were used to prevent this. Data are given for preparing 45° incidence neutral beam splitters in this way. W.Weinstein

535.391 : 539.234

992. VARIATIONS, AS A FUNCTION OF THE THICKNESS, OF THE REFLECTING POWER IN THE FAR ULTRAVIOLET OF THIN FILMS OF MAGNESIUM FLUORIDE. D.Fabre.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2241-4 (Dec. 16, 1957). In French.

The reflecting power was studied in the far ultraviolet for evaporated thin films of magnesium fluoride, of thickness between 350 and 8700 A. Measurements are reported in the wavelength range 1000 to 1700 A. The films exhibit the phenomena of interference, curves being shown for variation with wavelength. Reflecting coefficients vary and reach about 15%. An increase in reflecting power with time (observations made from one day to six months) is reported. S.Tolansky

535.391 : 539.234

993. OPTICAL PROPERTIES OF MAGNESIUM FLUORIDE FILMS IN THE ULTRAVIOLET. J.F.Hall, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 7, 662-5 (July, 1957).

The dispersion of films of magnesium fluoride evaporated on quartz substrates was determined interferometrically in the ultraviolet from the wavelengths of the maxima and minima of reflectance and the thickness of the film. The refractive index of freshly deposited films was 1.375 at 4200 A and increased to 1.42 at 2100 A. The index increased approximately 1% as the films aged. The index of refraction of magnesium fluoride at the air–film and film–substrate interfaces, and the extinction coefficient, were determined from the reflectance and transmittance at normal incidence. The index at the film–substrate interface was consistent with the interferometrically determined index for the new and aged films. However, the apparent refractive index at the air–film interface depended upon the deposition rate and the thickness of the film and coincided with the interferometrically measured index only for the thinnest films investigated. The equations for the transmittance and reflectance of absorbing inhomogeneous films are derived. The density of the films was 2.96 g/cm^3 and together with thickness was invariant with age. A.

535.393 : 537.311.62

994. THE THEORY OF THE ANOMALOUS SKIN EFFECT IN METALS FOR OBLIQUELY INCIDENT RADIATION. J.G.Collins.
Appl. sci. Res. B, Vol. 7, No. 1, 1-40 (1958).

The problem of the anomalous skin effect in metals is studied theoretically for the case of obliquely incident radiation. It is shown that at upper visible and ultraviolet frequencies, the effective surface impedance of a metal varies with the direction of polarization of the incident radiation. Differences are of the same order of magnitude as terms arising from the displacement current. As a result, formulae for refractive indices, reflectivities and the principal angles at oblique incidence must be rederived in terms of two surface impedances. By a generalization of Dingle's method (Abstr. 1321/1954), expressions are obtained for the optical constants which are valid for all angles of incidence and for frequencies not lying within internal photoelectric absorption bands. Experimental results for the principal azimuth for silver are shown to be in closer agreement with the present theory than with either the Drude–Kronig theory or the theory of the anomalous skin effect assuming a single impedance. Suggestions are made to guide future experimental work in metal optics. A.

535.399

995. THE PROBLEM OF DETERMINATION OF OPTICAL CONSTANTS BY REFLECTION. N.G.Bakhshiev.
Optika i Spektrosk., Vol. 2, No. 6, 818-19 (1957). In Russian.

The author considers the layouts of Conn and Eaton (Abstr. 9141/1954) and of Beattie (Abstr. 2629/1955) and gives an analysis leading to a general expression for the transmission of a polarizer–specimen–analyser system. It is then shown how to determine the optical constants of isotropic absorbing media by taking two intensity measurements at angles of the polarizer with respect to the plane surface of the specimen of $\pm\pi/4$ and one measurement of the angle of the polarizer for extremal transmission ($\pm\beta_0$). C.R.S.Manders

535.412

996. INTERFERENCE FRINGES WITH CYLINDRICALLY CURVED THIN FILMS. N.Barakat.
J. Opt. Soc. Amer., Vol. 48, No. 2, 92-4 (Feb., 1958).

The theory of formation and localization of multiple beam interference fringes formed by a cylindrically curved interferometer enclosing a refracting medium in transmission and at reflection is given. The effect of varying the refractive index of enclosed medium on localization is considered. The resulting interference system formed by cylindrically curved doubly silvered phlogopite mica sheets in transmission is obtained and discussed. Its formation and localization are in accordance with theory. A.

535.412

997. FIZEAU-TYPE INTERFERENCE BETWEEN BEAMS OF LIGHT REFLECTED FROM THREE SURFACES. A.H.Cook.
J. sci. Instrum., Vol. 34, No. 11, 455-8 (Nov., 1957).

Optical interference phenomena between beams of light reflected from three surfaces are described and analysed. The distinctive feature of the fringe system is that the field is crossed by bands of intensity equal to that of light reflected from one of the surfaces, delineating the lines of constant separation of the other two surfaces. The use of the phenomena in metrology is briefly discussed. A.

535.417

998. SPHERICAL ABERRATION IN THE FIZEAU INTERFEROMETER. W.G.A.Taylor.
J. sci. Instrum., Vol. 34, No. 10, 399-402 (Oct., 1957).

The drawbacks of types of instruments in common use are reviewed. It is shown that primary aberration theory predicts quite accurately the errors introduced even by simple collimators with large aberration. The advantages of using a collimating lens based on a multiple-meniscus design are indicated, and the performances of several lens-systems are compared. A.

535.435 : 541.64

999. THE SCATTERING OF LIGHT BY MACROMOLECULAR CHAINS IN SOLUTION IN A GOOD SOLVENT. H.Benoit.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2244-7 (Dec. 16, 1957). In French.

Outlines a theory of the effects of long distance interactions on the stiffening of Gaussian chains and the resultant modification in the angular distribution of scattered light. G.F.Lothian

535.435

1000. DEPOLARIZED SCATTERING OF LIGHT IN LIQUIDS AND RELAXATION PROCESSES. I.L.Fabelinskiĭ.
Optika i Spektrosk., Vol. 2, No. 4, 510-13 (1957). In Russian.

The author refers to his interference method of studying the wing of the Rayleigh line (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 87, 538, 1953). He discovered that directly adjacent to the non-displaced line there is an intense narrow interval of depolarized scattering, with a half-width from 2.5 to a small fraction of cm^{-1}, passing continuously into a broader wing with a half-width of about 25 cm^{-1}. Each of these two intervals is equally well described by the relaxation theory formulae, provided that two different times of anisotropy relaxation are used. The relaxation times can be, conversely, calculated from the distribution of intensity in the wing. It was found that, for several liquids of low viscosity, fluctuations of anisotropy related to the "narrow part of the wing" vary 10-100 times more slowly than those related to the "broad part of the wing". The "broad part of the wing" in more viscous liquids was studied earlier (I.L.Fabelinskiĭ, Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 11, 382, 1947). The present paper deals with the "narrow part of the wing"; it is found that, for salol, glycerol, triacetin and benzophenone, the wing broadens as temperature rises (i.e., as viscosity decreases), and this is accompanied by appearance of the Mandelshtam-Brillouin components which are not visible at room temperature. For salol, viscosity falls roughly in the ratio 80/1, while the relaxation time increases roughly in the ratio 1/4, as temperature rises from 20 to 170°C. The obtained relaxation times show great deviations from those calculated on the basis of Leontovich's formula whereas no such deviations are obtained in the case of non-viscous liquids. F.Lachman

535.514.2

1001. POLARIZATION OF LIGHT REFLECTED BY A PILE [OF GLASS PLATES]. M.P.Lisitsa and A.A.Shishlovskiĭ.
Optika i Spektrosk., Vol. 2, No. 5, 637-44 (1957). In Russian.

A pile of plates is used, since only about 7% of the incident light is reflected by a single plate. The incident beam is usually divergent, so that only axial rays can be made to satisfy Brewster's condition for complete polarization. Polarization P due to a pile of m plane-parallel glass plates, each of refractive index n, is a function of m, n and φ, where φ = the angle of incidence. An increase of m causes narrowing of $\Delta\varphi$, the range of incident angles at which maxima of P occur. An increase of the refractive index (n) makes this effect of m on $\Delta\varphi$ very pronounced. In a single plate the incident ray is broken up by multiple reflections into secondary rays.

The number of these secondary rays, k, depends on the plate thickness, its length and the angle of incidence of the original ray. The effect of k on polarization P in a single plate is shown in figures.
S.Chomet

535.551

1002. THE STRESS BIREFRINGENCE RELATION IN SOME ALKALI HALIDES. K.G.Bansigir and K.S.Iyengar.
Proc. Phys. Soc., Vol. 71, Pt 2, 225-30 (Feb., 1958).

The stress birefringence relation in the alkali halides KBr, KCl and NaCl has been studied employing for the purpose a modified form of Filon's spectrometer method. A linear law is found to hold for stresses ranging from zero to 25 $kg.cm^{-2}$. Curves are given showing the photoelastic dispersion of these solids. A.

535.562

1003. SIMPLIFIED TREATMENT OF ELLIPSOMETRY.
J.A.Faucher, G.M.McManus and H.J.Trurnit.
J. Opt. Soc. Amer., Vol. 48, No. 1, 51-4 (Jan., 1958).

A straightforward treatment of the properties of elliptically polarized light reflected from thin films is made using only the laws of elementary optics. The results are shown to be in satisfactory agreement with experiment for films of thickness up to 1600 A, far beyond the region of validity of the Drude approximation for very thin films. A.

535.563

1004. THE THEORY OF THE NATURAL OPTICAL ACTIVITY OF MOLECULAR CRYSTALS. II. QUANTUM THEORY.
V.M.Agranovich.
Optika i Spektrosk., Vol. 2, No. 6, 738-46 (1957). In Russian.

Theoretical paper, a sequel to an earlier one (Abstr. 4252/1957), where the classical calculation of the optical activity of molecular crystals was carried out. Here the quantum theory is developed. General formulae are obtained for dispersion of optical activity and summation rules are examined. C.R.S.Manders

535.568.1

1005. A HIGH-PRECISION PHOTOELECTRIC POLARIMETER.
E.J.Gillham.
J. sci. Instrum., Vol. 34, No. 11, 435-9 (Nov., 1957).

In this instrument, which is designed primarily for standardization work on quartz control plates, the half-shade principle familiar in visual polarimeters is realized, in a slightly different form, by means of a revolving disk carrying segments of optically-active quartz. These cause the plane of polarization of the light incident on the analyser to alternate between two positions at a low audiofrequency; the setting position of the analyser is that in which the intensity of the emergent light, as indicated by means of a photomultiplier and a.c. amplifier, is unmodulated. The precision of setting is about ten times better than that of a visual instrument. For measuring specimens of small optical activity, use is made of the Faraday effect to balance out the rotation produced by the specimen, thus obviating the need for angular scale readings. A.

535.6 : 621.397.3

1006. INTERNATIONAL SYMPOSIUM. PHYSICAL PROBLEMS OF COLOUR TELEVISION.
Acta electronica, Vol. 2, No. 1-2, 1-419 (1957).

This symposium was held at the Conservatoire National des Arts et Métiers, Paris, in July 1957. Abstracts of the papers will be published individually.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.8 : 537.228.4

KERR-EFFECT LIGHT MODULATOR. See Abstr. 1037

535.81

1007. NOTE ON THE POLISHING OF FLUORITE WINDOWS.
E.J.Slowinski, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1034 (Nov., 1957).

A saturated aqueous solution of the disodium salt of ethylenediaminetetra-acetic acid was used as a polishing medium for CaF_2, which is slowly dissolved by chelating action on the calcium ions. A good polish was obtained in 15 min compared with more than an hour by conventional methods. W.Weinstein

HEAT

536.2.083

1008. THE APPLICATION OF A TRANSIENT METHOD TO THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF ROCKS AND BUILDING MATERIALS. G.Gafner.
Brit. J. appl. Phys., Vol. 8, No. 10, 393-7 (Oct., 1957).

A transient method of measuring the thermal conductivity of insulators has been modified to allow measurements to be made on rocks and building materials in the approximate thermal conductivity range 0.008 to 0.07 J/cm deg C sec, with an accuracy of 7% or better. A detailed description is given of the apparatus, experimental procedure and corrections to be applied to the results obtained. A.

536.2.083 : 536.62

1009. A METHOD OF MEASURING THE THERMAL CONSTANTS OF GRANULAR MATERIALS. T.S.E.Thomas.
Brit. J. appl. Phys., Vol. 8, No. 10, 403-5 (Oct., 1957).

Thermal constants of granular materials are determined by measuring the temperature changes at the centre and surface of a metal cylinder containing the material. Heat is supplied to the cylinder wall at a constant rate by a resistance winding, and surface heat loss is eliminated by an outer screening tube kept at the same temperature by manual or automatic control. A.

536.27 : 532.25

1010. THE THERMAL INSTABILITY OF A ROTATING FLUID SPHERE HEATED WITHIN. II. S.Chandrasekhar.
Phil. Mag. (Eighth Ser.), Vol. 2, 1282-4 (Oct., 1957).

For Pt I see Abstr. 8554 (1957). It is shown that the characteristic value problem specifying the state of marginal stability of a rotating incompressible fluid sphere heated within, can be reformulated in terms of a variational principle. A.

536.33.08

1011. DESIGN OF A RADIATION BOLOMETER. M.I.Kornfel'd.
Zh. tekh. Fiz., Vol. 27, No. 11, 2652-61 (1957). In Russian.

536.413

1012. THERMAL EXPANSION OF SOLIDS AT HIGH TEMPERATURES. J.N.Eastabrook.
Phil. Mag. (Eighth Ser.), Vol. 2, 1421-6 (Dec., 1957)

In a theory of thermal expansion above the Debye temperature, the increases of specific heat and Grüneisen's γ with temperature are taken into account. The increase of expansion coefficient with temperature observed in several simple substances is shown to be about that expected for a perfect crystal. It is not evidence for the thermal generation of defects in the crystal. A.

536.413

1013. THE THERMAL EXPANSION OF IRON DITELLURIDE.
J.P.Llewellyn and T.Smith.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1113-22 (Dec., 1957).

The variation with temperature of the unit cell dimensions of two samples of orthorhombic iron ditelluride $FeTe_{2.00}$ and $FeTe_{2.10}$, was measured between 17° C and 550° C using the X-ray powder method. It is found that Grüneisen's relation between the volume expansion coefficient and specific heat is adequate for $FeTe_{2.00}$, but Grüneisen and Goen's theory of the linear expansion coefficients is not satisfactory. A comparison between the expansion rates of $FeTe_{2.00}$ and $FeSb_2$ lends weight to the proposed existence of additional metalloid—metalloid bonds in the latter compound. The difference between the expansion curves of $FeTe_{2.00}$ and $FeTe_{2.10}$ cannot be explained in terms of additional covalent bonds and must be attributed to an increase in the ionic character of the bonds, which is associated with the vacancies present at the Te-rich composition. A.

536.421.3

1014. NUCLEATION AT A LIQUID—LIQUID INTERFACE.
L.Trefethen.
J. appl. Phys., Vol. 28, No. 8, 923-4 (Aug., 1957).

Drops of water were surrounded with mineral oil and mercury, and drops of CS_2 with water and mercury. A drop of approximately $\frac{3}{16}$ in. diameter rested on a mercury surface made concave upwards by contact with a circumscribing, previously amalgamated, ring. By means of a vacuum, the pressure in the water drops was reduced to a value corresponding to a superheat of 30° C for water drops, and 50° C for the CS_2 drops. In addition, the CS_2 drops were subjected to heat corresponding to 50° C superheat. The results indicated that

nucleation occurs with difficulty, if at all, at liquid–liquid interfaces. The technique described provides a simple means of obtaining superheated liquid drops which are accessible to probes. J.Iball

536.421.4

1015. A CLOUD CHAMBER AT A QUASI-UNIFORM TEMPERATURE FOR STUDIES OF THE THRESHOLD OF ICE FORMATION. R.Montmory.
J. Phys. Radium, Vol. 18, No. 5, 362-3 (May, 1957). In French.

Describes the chamber, built in a commercial ice-box, and the method used to produce a cloud, which is claimed not to disturb the uniformity of the conditions. Precise temperature measurements show only a small vertical gradient and a very slow time variation enabling the determination of thresholds to $\pm 0.25^{\circ}$C. K.H.Barker

536.424

1016. THE EFFECT OF LIQUID MEDIA ON THE GREY TIN ⇌ WHITE TIN TRANSFORMATION IN COMMERCIALLY PURE TIN. R.W.Smith and G.V.Raynor.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1135-42 (Dec., 1957).

Dilatometric experiments using xylene, ethyl alcohol, alcoholic "pink salt" solution and distilled water show that the rate of transformation of the $\alpha \rightarrow \beta$ and $\beta \rightarrow \alpha$ reactions in tin are affected by the surrounding medium. The $\alpha \rightarrow \beta$ rate for material which has undergone one previous $\beta \rightarrow \alpha$ change is greater in water or ethyl alcohol than in xylene. All rates increase with temperature up to the highest investigated (29.86°C), and do not reach a maximum at about 25°C as reported by earlier workers. Alcoholic "pink salt" solution produces a much higher $\beta \rightarrow \alpha$ transformation rate than other liquids in specimens which have undergone two successive transformations. The effects of xylene and ethyl alcohol during repeated transformation were studied at 30°C and 50°C; $\alpha \rightarrow \beta$ rates were highest at the higher temperature. At 30°C, transformation rates increased with repeated transformation under xylene, but decreased under ethyl alcohol. It is suggested that xylene behaves as an inert liquid, while the effects observed with other liquids are due to the presence of a hydroxyl group. The increase of $\beta \rightarrow \alpha$ transformation rate obtained with alcoholic pink salt is considered to be due to the reducing nature of the medium, and the formation of local electrolytic cells of various types. The results of certain earlier investigations are discussed on the basis of this work. A.

536.424 : 537.312.62

SUPERCOOLING EFFECT IN SUPERCONDUCTORS CLOSE TO THE TRANSITION TEMPERATURE. See Abstr.620

536.424.1

1017. TENTATIVE PHASE DIAGRAM FOR SOLID H_2S. R.Stevenson.
J. chem. Phys., Vol. 27, No. 1, 147-50 (July, 1957).

The solid phases of hydrogen sulphide under high pressures were studied by the volume discontinuity method. Evidently two new solid phases were observed. The natures of the freezing transition and the higher temperature solid–solid transition are discussed, and the results are compared with the analogous case of water. A.

536.424.1 : 548

1018. REMARKS ON A POLYMORPHIC TRANSFORMATION OF CAMPHOR CRYSTALS. J.Jaffray.
J. Phys. Radium, Vol. 18, No. 4, 280 (April, 1957). In French.

$C_{10}H_{16}O$ crystals have two polymorphic transformations at atmospheric pressure: from rhombohedral structure III to rhombohedral II at about −30°C and from II to cubic I at about +90°C. The second transformation has been less studied and the author presents additional experimental data. From differential thermal analysis the transformation temperature was 90 ± 2°C (heating) and 88°C (cooling) for various specimens of m.p. ranging from 175 to 178°C. The heat of transformation was $< 1/50$ the heat of fusion. Dilatometry showed that the transformation for heating was sharp, occurred at 91.5 ± 1°C and was accompanied by an increase in volume of 0.116 cm^3/mole. S.Weintroub

536.44 : 536.423.1 : 541.11

1019. PREDICTION OF CRITICAL TEMPERATURES. D.K.H.Briggs and W.D.Drake.
Nature (London), Vol. 180, 1353 (Dec. 14, 1957).

An equation relating critical temperature, boiling point and density is obtained by a least square fit to data for a number of organic substances. P.Gray

536.461

1020. RATE OF PROPAGATION OF PROPANE–AIR FLAMES IRRADIATED WITH A 10 000 CURIE GOLD SOURCE. S.W.Churchill, A.Weir, Jr, R.L.Gealer and R.J.Kelley.
Industr. engng Chem., Vol. 49, No. 9(I), 1419-22 (Sept., 1957).

Using a flame-area method, burning velocities have been measured at reduced pressure (4 to 10 in. Hg) for various mixture strengths. Curves indicate a marked increase (40 to 80%) for irradiation with a 10380 curie source, and a less marked increase (10 to 25%) with 8420 curies. The number of ion pairs, produced mostly by β-rays, is calculated. Possible effects of slight heating are discussed. A.G.Gaydon

536.461 : 535.333

1021. EMISSION SPECTRA OF PROPANE–AIR FLAMES IRRADIATED WITH A 1000 CURIE GOLD SOURCE. A.Weir, Jr, S.W.Churchill, L.F.Ornella and M.E.Gluckstein.
Industr. engng Chem., Vol. 49, No. 9(I), 1423-8 (Sept., 1957).

The intensities of CH, C_2 and OH bands have been measured at various heights, mixture strengths and pressures. In flames at reduced pressure (see preceding abstract), CH and C_2 are strengthened by irradiation, but OH is not. The effect is greater for the higher pressures and richer mixtures. A.G.Gaydon

536.48

1022. SUMMARIZED PROCEEDINGS OF A MEETING ON LOW TEMPERATURE DISTILLATION — LONDON, MARCH 1957. F.Din.
Brit. J. appl. Phys., Vol. 8, No. 11, 436-41 (Nov., 1957).

A meeting held by the Low Temperature Group of the Physical Society, London. Summaries of the papers that were read and discussed are given.

536.48

1023. MEASUREMENTS OF THE HEAT OF TRANSPORT OF LIQUID HELIUM II. D.F.Brewer and D.O.Edwards.
Proc. Phys. Soc., Vol. 71, Pt 1, 117-25 (Jan., 1958).

The heat of transport of helium II has been measured accurately from 1.15°K to 2.1°K in order to compare it with the calorimetric entropy data. The measurements were made with a thermally isolated glass vessel, which was connected to an isothermal liquid-helium bath by a tube packed with fine powder. The heat of transport was determined (i) from the temperature and hydrostatic pressure changes in the vessel during thermomechanical flow, and (ii) from the heat input necessary to produce a measured flow rate. The results agree well with the indirect measurements of the fountain effect by van den Meydenberg, Taconis, Beenakker and Wansink and with the calorimetric data of Kramers, Wasscher and Gorter. The agreement with Kramers et al. is within the experimental error up to 1.8°K but at higher temperatures the present measurements are slightly higher. Oscillations in the temperature of the vessel were observed even during thermomechanical flow, provided that the rate was subcritical. As expected, the oscillations were damped out above the critical rate. When the flow was just critical, a pronounced peak in the temperature–time graph was observed at the beginning of the flow, which appears to be due to an unexplained irreversible process. A.

536.48

1024. THE THEORY OF LIQUID ^{4}He. J.Wilks.
Rep. Progr. Phys., Vol. 20, 38-85 (1957).

An account is given of the present state of the theory of liquid He^4. At low temperatures it is no longer possible to consider the motion of individual atoms, and a wave-mechanical treatment becomes necessary. Such a treatment, as developed by Landau and Feynman, characterizes the thermal motion of the liquid by "elementary excitations", the so-called phonons and rotons. A consideration of these excitations then leads to the "two-fluid" model. It is shown that the treatment is adequate to account for nearly all the properties of the liquid, which are briefly reviewed. The principal problem still outstanding concerns the behaviour of the liquid at high rates of flow or when carrying a large heat current, when it is clear that some form of turbulence is induced. A.

536.5.081 : 538.222

1025. IDENTITY OF SPIN TEMPERATURE AND THERMODYNAMIC TEMPERATURE. A.Abragam and W.Proctor.
C.R. Acad. Sci. (Paris), Vol. 245, No. 13, 1048-50 (Sept. 23, 1957). In French.

The experimental verification is described of a hypothesis (Abstr. 3633/1951) of thermal equilibrium within the nuclear spin-system, corresponding to a temperature (defined in certain magnetic resonance experiments) different from that of the lattice. A LiF crystal is used, and some relaxation times of Li^7 are given. P.Gray

536.531

1026. A SIMPLE CALIBRATION TECHNIQUE FOR IMPROVING THE ACCURACY OF A SMITH RESISTANCE THERMOMETRY BRIDGE. G.C.Lowenthal.
Brit. J. appl. Phys., Vol. 8, No. 11, 449-52 (Nov., 1957).

The Smith resistance thermometry bridge is subject to irregular drifts which cause errors exceeding ±0.002 deg C between 0 and 100°C and ±0.01 deg C at 630°C. These errors cannot be dealt with successfully by potentiometric calibrations. An analysis shows, however, that provided certain conditions are satisfied, an external decade of stable 10 Ω resistors can be used to reduce the errors to ±0.0005 and ±0.001 deg C respectively, since the calibration is sufficiently simple and quick to be repeated as often as required. A.

536.631

1027. THE ATOMIC HEATS OF TITANIUM, ZIRCONIUM AND HAFNIUM. N.M.Wolcott.
Phil. Mag. (Eighth Ser.), Vol. 2, 1246-54 (Oct., 1957).

The specific heats of these metals were measured between 1.2 and 20°K. Values of γ, the electronic specific heat coefficient, were determined for these metals as 8.5, 7.25 and 6.3×10^{-4} cal/mole. deg^2, while the corresponding values of the Debye θ in the continuum region are 430°, 310° and 261°. The variation of θ with temperature was investigated, and it is shown that there is a similarity in this variation for all three elements when a suitably reduced scale of temperature is used. A.

536.631

1028. SPECIFIC HEAT OF SOLIDS AT HIGH TEMPERATURES. J.N.Eastabrook.
Phil. Mag. (Eighth Ser.), Vol. 2, 1415-20 (Dec., 1957).

The temperature dependence of the specific heat of simple crystals at temperatures well above the Debye temperature is estimated by using, as a simple model, the two-atom anharmonic oscillator. It is found that the difference between C_V and the Dulong and Petit value is not much less than the difference between C_P and C_V. There is rough agreement with experiment. A.

536.631

1029. THE HEAT CAPACITY OF DIAMOND BETWEEN 12.8° AND 277°K. J.E.Desnoyers and J.A.Morrison.
Phil. Mag. (Eighth Ser.), Vol. 3, 42-8 (Jan., 1958).

The heat capacity of 160 g of diamonds was measured in the temperature range 12.8° to 277°K with estimated accuracies of ±20% at 13°K, ±6% at 20°K, ±0.8% at 100°K and ±0.2% for $T > 200$°K. Fitting of the results in the region $T > \Theta_D$ 20 to the low temperature expansion for the heat capacity gives $\Theta_0 = 2219 \pm 20$°K; this agrees excellently with Θ (elastic) = 2240 ± 5°K, derived from elastic constants determined by McSkimin and Bond. Down to 75°K the results are in reasonable agreement with earlier measurements of DeSorbo, but at lower temperatures an anomaly reported by DeSorbo has not been confirmed. A.

536.631

1030. HEAT CAPACITY BETWEEN 1.8 AND 4.2°K OF AN IRON—CHROMIUM ALLOY IN THE ALPHA AND SIGMA PHASES. F.E.Hoare and J.C.Matthews.
Proc. Phys. Soc., Vol. 71, Pt 2, 220-4 (Feb., 1958).

The alloy contained 44.1 atomic per cent chromium, where the pure sigma-phase may be precipitated by prolonged annealing. In the alpha-phase the specific heat is almost identical with that of pure iron. In the sigma-phase however, a larger specific heat appears which is linear with temperature, and this is assumed to be electronic in origin giving for γ, 26.8×10^{-3} J.deg^{-2}.mole^{-1}, which is greater than has been observed for any other metal or alloy (γ is given by $C_V = \gamma T + \beta T^3$, where C_V = specific heat, T = temperature). A.

ELECTRICITY

ELECTROSTATICS. DIELECTRICS

537.226

1031. LIMIT-PERIODIC DIELECTRIC MEDIA. R.M.Redheffer.
J. appl. Phys., Vol. 28, No. 7, 820-1 (July, 1957).

The most general limit-periodic medium in Abstr. 1250 (1957) consists of a stack of identical inhomogeneous dielectric sheets. In the simplest medium the sheets are replaced by identical units each consisting of two homogeneous dielectric sheets of the same thickness but different properties. This note shows that the general medium is no more general than the simplest medium and that if the representation is possible at all it is possible with the simplest medium. R.C.Kell

537.226.1

1032. DIELECTRIC DISPERSION IN VISCOUS POLAR LIQUIDS. J.W.Winslow, Jr, R.J.Good and P.E.Berghausen.
J. chem. Phys., Vol. 27, No. 1, 309-12 (July, 1957).

The dielectric dispersion was studied over the range 50 c/s to 100 kc/s for the following liquids: tolyl xylyl sulphone, pentachlorobiphenyl, hexachlorobiphenyl and solutions of tolyl xylyl sulphone in supercooled o-terphenyl. The results in all three cases conformed to the unsymmetrical dispersion equation of Davidson and Cole. A possible explanation for the deviation from Debye-type behaviour is discussed. A.

537.226.2 : 535.371

1033. ON TWO DISTINCT TYPES OF PHOTODIELECTRIC EFFECT IN CADMIUM SULPHIDE.
R.Freymann, E.Grillot, M.Hagene and J.Le Bot.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2261-4 (Dec. 16, 1957). In French.

Dipolar Debye absorption occurred under excitation in CdS powders, indicating the existence of a level at 0.02 eV below the conduction band. In addition an abnormal absorption band was observed, which did not obey the Debye relations. J.Franks

537.226.2 : 535.371

1034. EFFECT OF THE INTENSITY AND THE EXCITATION TIME ON THE PHOTODIELECTRIC PROPERTIES OF ZINC SULPHIDE ACTIVATED WITH COPPER.
B.Hagène and J.J.Le Fèvre.
J. Phys. Radium, Vol. 18, No. 6, 412-13 (June, 1957). In French.

After irradiating specimens of ZnS : Cu at 80°K at various intensities and for various durations, dielectric loss measurements were made at 1 kc/s while the specimens heated up in the dark and under irradiation. The maximum dielectric loss is proportional to the logarithm of both the intensity and the duration of irradiation, the constant of proportionality increases abruptly at a certain value of the intensity depending on the conditions of excitation. J.Franks

537.226.2

1035. QUASI-STATIC HYSTERESIS IN BARIUM-TITANATE SINGLE CRYSTALS. Z.Kiyasu, K.Husimi and K.Kataoka.
J. Phys. Soc. Japan, Vol. 12, No. 4, 432 (April, 1957).

The absolute value of polarization at any instant was determined by a piezoelectric method. Hysteresis loops traced out by this means at a very slow rate showed some novel features, including a virtually infinite maximum slope, some very slowly polarizing components, and an asymmetry related to the manner of growth of the crystal. K.W.Plessner

537.226.2

1036. EFFECT OF IRON GROUP IONS ON THE DIELECTRIC PROPERTIES OF $BaTiO_3$ CERAMICS. T.Sakudo.
J. Phys. Soc. Japan, Vol. 12, No. 9, 1050 (Sept., 1957).

The variation of the Curie temperature, measured as the peak in the permittivity—temperature curve at 70 kc/s, has been determined for $BaTiO_3$ ceramics containing added Fe, Ni, Co, Mn and Cu ions. With Fe, Ni, Co and Mn, the Curie temperature is lowered but the effects saturate at low concentrations of the added ions, probably due to limited solubility in the $BaTiO_3$ lattice. With Cu ions, the Curie temperature is raised, and continues to increase up to concentrations of 40 atomic per cent Cu, the highest examined. L.E.Cross

537.228.4 : 535.8

1037. A HIGH SPEED LOW VOLTAGE LIGHT MODULATOR. A.C.Koelsch.
I.R.E. Nat. Convention Record, Vol. 5, Pt 3, 169-77 (1957).

Barium titanate single crystals have a marked Kerr effect when held above their Curie temperature. This property is significant for applied fields well below those required for more common Kerr materials. Light pulses of reasonable amplitude and about 50 mμsec duration have been realized with an applied voltage of only 150 volts. The general theory of Kerr effect light modulators is discussed, and an experimental light modulator is described. A.

537.228.4 : 532.77

1038. ON THE INNER FIELD IN THE KERR EFFECT OF DIPOLAR LIQUIDS. A.Steppuhn.
Z. Naturforsch., Vol. 11a, No. 11, 912-19 (Nov., 1956). In German.

On the basis of work by Klages (Abstr. 282/1955) a relation for the Kerr constant of polar molecules in the liquid phase is derived. Application to solutions of methylethylketone, methylisobutylketone, n-dodecylchloride, di-n-butylether in hexane and cyclohexane shows the Kerr constants to remain independent of concentration throughout. Earlier interpretation and measurement of such dependence must mainly be due to a faulty expression for the inner field. In benzene however both ketones show a marked dependence of the molar Kerr constant on concentration. J.Jacobs

ELECTRIC CONDUCTION. CURRENTS

537.311.3.08 : 538.632.08

1039. A METHOD OF MEASURING SPECIFIC RESISTIVITY AND HALL EFFECT OF DISCS OF ARBITRARY SHAPE.
L.J.van der Pauw.
Philips Res. Rep., Vol. 13, No. 1, 1-9 (Feb., 1958).

A method of measuring resistivity and the Hall effect of flat samples of arbitrary shape is presented. The method is based upon a theorem which holds for a flat sample of arbitrary shape if the contacts are sufficiently small and located at the circumference of the sample. Furthermore, the sample must be singly connected, i.e. it should not have isolated holes. A.

537.311.31 : 539.219

1040. ON THE RESISTIVITY ANOMALIES IN SOME DILUTED ALLOYS. J.Korringa.
Canad. J. Phys., Vol. 34, No. 12A, 1290-8 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). Suggests that no simple scattering mechanism can account for recent experiments on dilute alloys of Mn in Cu. The author's previous hypothesis of resonance scattering (Abstr. 8609/1953) leads to the correct type of temperature dependence for the resistivity and may be correlated with other properties, including the Cu nuclear resonance data reported by Kittel and others (Abstr. 6019/1956). A report is given of extensive discussion on resistivity anomalies in many alloys. D.M.Edwards

537.311.31

1041. PHENOMENOLOGICAL ASPECTS OF THE RESISTIVITY OF PURE METALS. G.Borelius.
Canad. J. Phys., Vol. 34, No. 12A, 1336-41 (Dec., 1956).

"Electron transport" Conference paper (see Abstr. 8734/1957). The author's plot of U, the potential part of the thermal energy, against the volume thermal expansion shows continuity between the solid and liquid states (Abstr. 7055/1957). Some evidence is given for the existence of similar continuity in the relationship between the resistivity and U (see Abstr. 7248/1957). D.M.Edwards

537.311.31 : 536.212

1042. THE INFLUENCE OF HEAT-TREATMENT ON THE ELECTRICAL RESISTIVITY AND THE THERMAL CONDUCTIVITY OF ELECTRODEPOSITED CHROMIUM. R.W.Powell and R.P.Tye.
J. Inst. Metals, Vol. 24, Pt 5, 185-92 (Jan., 1957).

The thermal and electrical conductivities of electrodeposited chromium are shown to increase as a result of heat-treatment. A detailed investigation of these properties has been made over a wide range of temperatures and for heat-treatment temperatures extending to 1410°C. After heat-treatment at 1410°C the thermal conductivity at 50°C was 3.65 times the original value for the as-deposited material. From consideration of the relationship between the thermal and electrical conductivities, the conclusion is reached that the thermal conductivity appears to have a considerable lattice component which is a function of heat-treatment as well as of temperature. The well-known normal-temperature anomaly in the properties of chromium became apparent in the resistivity/temperature curve only after heat-treatment at 545°C. This anomaly is discussed in some detail, and the tentative suggestion is made that it may be associated with the presence of chromic oxide. A.

537.311.32

1043. PLASMA AUGMENTATION OF THE SURFACE CONDUCTIVITY OF GLASSES. R.G.Fowler and M.Sakuntala.
J. chem. Phys., Vol. 27, No. 3, 824-5 (Sept., 1957).

A superficial electrical conductance is observed on normally nonconducting glasses such as "Pyrex" after they are in contact with ionized gases. At plasma concentrations of order 10^{16}-10^{17} ions/cm^3 surface conductivities, assumed to result from electronic processes, of order 1 mho per square are obtained. C.A.Hogarth

537.311.33

1044. MAGNETIC FIELD EFFECTS ON ELECTRON POPULATIONS IN SEMICONDUCTORS. P.T.Landsberg.
Proc. Phys. Soc., Vol. 71, Pt 1, 69-76 (Jan., 1958).

This paper gives a calculation of the change in population of the states of the conduction band when a magnetic field is applied. It is based on two main suppositions: first, that the conduction band states are shifted up or down by an energy d due to the interaction of their spins with the magnetic field; secondly, that the donor states are also shifted up or down in energy by the same amount d. The more important general properties of the model are discussed, and a numerical example is worked out in some detail. It is also shown that different results are obtained according to which of two different pictures of the nature of the donor levels one adopts. The first of these pictures is the usual one, which excludes the possibility of having more than one electron on a given donor ("localized" states). The second assumes as before that the levels of either spin are sharp in energy, but postulates that these levels can be populated in any manner consistent with the exclusion principle, as in the ordinary theory of metals ("non-localized" impurity states). A.

537.311.33 : 538.66

1045. THE THEORY OF THE NERNST EFFECT IN SEMICONDUCTORS. J.E.Parrott.
Proc. Phys. Soc., Vol. 71, Pt 1, 82-7 (Jan., 1958).

The effects of phonon–electron drag on the Nernst effect are examined using general methods described in an earlier paper (Abstr. 7096/1957). Following an account of the physical processes involved in this effect, there is a calculation of the Nernst coefficient in some simple cases. It is shown that the sign of the Nernst coefficient can be altered by a phonon current as has been found experimentally in germanium. Furthermore, a quantitative comparison of the theory with these experiments shows satisfactory agreement. A.

537.311.33

1046. ELECTRICAL CONDUCTIVITY OF SINGLE CRYSTALS OF THE SILVER HALIDES. R.Matejec.
Z. Phys., Vol. 148, No. 4, 454-95 (1957). In German.

The temperature dependence of the conductivity of single crystals of AgCl and AgBr, both pure and containing anion and cation impurity, was measured from –183°C. (see also Abstr. 7106/1957). Linear portions of the conductivity–reciprocal-temperature curves are associated with the presence of different types of defect and the effects of quenching and annealing were investigated. Some photoconductivity results are discussed in the light of the conclusions drawn from the above. J.E.Caffyn

537.311.33 : 536.421.1

1047. CHANGE IN PROPERTIES OF SEMICONDUCTORS ON FUSION. A.I.Gubanov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2510-16 (1957). In Russian.

An attempt is made to estimate theoretically the change in properties of semiconductors on fusion or transition to amorphous state when the coordination number does not change. In particular, change in the width of the bands and effective masses of the current carriers on melting is associated with their change on deformation of the crystal.

537.311.33 : 535.345 : 539.213.2

1048. VITREOUS SEMICONDUCTORS. SOME PROPERTIES OF MATERIALS IN THE SYSTEM As_2Se_3–As_2Te_3. II.
T.N.Vengel' and B.T.Kolomiets.
Zh. tekh. Fiz., Vol. 27, No. 11, 2484-91 (1957). In Russian.

An investigation of the electrical properties in the above-mentioned system, which includes a large number of vitreous materials. The purpose of the investigation was to establish the correlation between the variation in the chemical composition of the glasses and their properties such as conductivity, photoconductivity, absorption of light, thermoelectric force, density, etc. It is concluded that conductivity in these glass-like semiconductors is electronic.

537.311.33

1049. SOME OPTICAL PROPERTIES OF Bi_2Te_3–Bi_2Se_3 ALLOYS.
I.G.Austin and A.Sheard.
J. Electrónics and Control, Vol. 3, No. 2, 236-7 (Aug., 1957).

The energy gap–composition curve for this semiconductor alloy system was determined from infrared measurements. The

energy gap increases linearly with the proportion of selenium atoms from Bi_2Te_3 to $Bi_2Te_{2.1}Se_{0.9}$. At the latter composition a sharp change of slope occurs and for higher proportions of selenium atoms the energy gap gradually falls. B.T.M.Willis

537.311.33 : 537.323 : 538.632

1050. THE CHARACTERISTIC TEMPERATURE AND EFFECTIVE ELECTRON MASS FOR CONDUCTION PROCESSES IN CADMIUM OXIDE. R.W.Wright and J.A.Bastin.
Proc. Phys. Soc., Vol. 71, Pt 1,109-16 (Jan., 1958).

Measurements of the Hall effect, resistance, magnetoresistive effect, and thermoelectric power have been made for in all over fifty specimens prepared by sintering compressed powder blocks of cadmium oxide. For all specimens the Hall effect has been measured at room temperature, and this provides a fairly accurate estimate of the conduction electron density. The results are compared in each case with the theoretical expressions for conduction in polar crystals given by Howarth and Sondheimer (Abstr. 4802/1953) and Lewis and Sondheimer (Abstr. 1815/1955). Of particular interest is the variation with temperature of the Hall coefficient. Changes are observed which are not ascribed to changes of electron concentration. The complete comparison gives values of the effective electron mass and the characteristic temperature for longitudinal optical vibrations. A.

537.311.33

1051. DETECTION OF BOTH VACANCIES AND INTERSTITIALS IN DEFORMED GERMANIUM. J.N.Hobstetter and P.Breidt, Jr.
J. appl. Phys., Vol. 28, No. 10, 1214-15 (Oct., 1957).

The electrical conductivity of high-conductivity p-type germanium decreases after deformation at 525°C. The effect is attributable to the introduction of donors and may be easily removed by annealing. It is suggested that point defects, namely interstitial atoms are responsible. C.A.Hogarth

537.311.33

1052. ON THE CARRIER RECOMBINATION THROUGH NICKEL IMPURITIES IN GERMANIUM. J.Okada.
J. Phys. Soc. Japan, Vol. 12, No. 6, 741 (June, 1957).

It is normally assumed that Cu, Au, Fe and Ni which act as trapping and recombination centres in Ge each introduce two acceptor levels whose charge distribution affects capture cross-sections for free carriers. Experiment and theory for Ni-doped Ge suggests that in one temperature range at least, this assumption is not necessary. C.A.Hogarth

537.311.33

1053. FREE BONDS ON THE CLEAN SURFACES OF GERMANIUM SINGLE CRYSTALS. A.Kobayashi and S.Kawaji.
J. Phys. Soc. Japan, Vol. 12, No. 9, 1054 (Sept., 1957).

Surface field effect was measured on a 40 Ω.cm p-type germanium single crystal, treated by heating in hydrogen, and then in a vacuum of 10^{-3} mm Hg. A fast-state density of 1.7×10^{13} $cm^{-2}.eV^{-1}$ was obtained for this clean surface and 2.4×10^{12} $cm^{-2}.eV^{-1}$ after exposure to oxygen. D.Haneman

537.311.33

1054. OXYGEN AS A DONOR ELEMENT IN GERMANIUM. G.Elliott.
Nature (London), Vol. 180, 1350-1 (Dec. 14, 1957).

Air admitted to intrinsic Ge during zone refining or crystal pulling converted it to low-resistivity n-type material. It is suggested that oxygen introduces donor levels, and that it is normally rendered inactive in most crystals, usually containing $1\text{-}3 \times 10^{16}$ atoms/cm^3 of oxygen (C.D.Thurmond, W.G.Guldner, and A.L.Beach, J.Electrochem. Soc., Vol. 103, No. 11, 603,Nov., 1956) by combination with similar amounts of hydrogen present. D.Haneman

537.311.33

1055. ELECTRON MULTIPLICATION IN GERMANIUM AND SILICON. Y.Watanabe.
Rep. Res. Inst. Elect. Commun. Tôkohu Univ. B, Vol. 7, No. 2, 45-66 (1955).

McKay and McAfee's data on avalanche multiplication is analysed in terms of Townsend's theory for gas ionization. The step and linear gradient p—n junctions are treated and the results of the analysis using gas ionization theory are shown to be formally the same as for the solid case. C.A.Hogarth

537.311.33

1056. DEPENDENCE OF THE LIFETIME OF INJECTED CURRENT CARRIERS ON THE CONCENTRATION OF ANTIMONY IMPURITY IN GERMANIUM. V.E.Lashkarev, V.G.Litovchenko, N.M.Omel'yanovskaya, R.N.Bondarenko and V.I.Strikha.
Zh. tekh. Fiz., Vol. 27, No. 11, 2437-9 (1957). In Russian.

The dependence of lifetime of injected current carriers on the concentration of antimony impurity was investigated up to values close to the limit of solubility of antimony in germanium. Optical methods were used for the measurement. The conclusion drawn from the results is that the impurity atoms of antimony are not directly effective recombination centres; but that uncontrolled,deeply embedded impurities, either introduced with the antimony or existing originally in the germanium, are responsible for recombination.

537.311.33

1057. INVESTIGATION OF THE FIELD EFFECT AND OF SURFACE RECOMBINATION IN GERMANIUM SPECIMENS. A.V.Rzhanov, Yu.F.Novototskiĭ-Vlasov and I.G.Neizvestnyĭ.
Zh. tekh. Fiz., Vol. 27, No. 11, 2440-50 (1957). In Russian.

It is shown that the effect of ozone on germanium specimens is to give rise to "fast" surface states, some of which are recombination states. The density and energy positions of all the states introduced by ozone are estimated, together with the cross-section of capture of an electron by recombination states. Preliminary data are obtained for the dependence of the rate of surface recombination upon the electrostatic surface potential, from which the ratio of the effective cross-sections of capture of an electron and a hole is determined.

537.311.33

1058. INVESTIGATION OF THE RECOMBINATION OF CURRENT CARRIERS IN GERMANIUM WITH IRON IMPURITY. K.D.Glinchuk, E.G.Miselyuk and N.N.Fortunatova.
Zh. tekh. Fiz., Vol. 27, No. 11, 2451-7 (1957). In Russian.

Investigation of non-equilibrium current carriers in n-type germanium with iron impurity. It is shown that the acceptor level found in such germanium and situated at 0.27 eV from the conduction band, is removed by annealing at t = 450-500°C, resulting in a sharp increase in the lifetime of non-equilibrium current carriers. The supposition is made that the observed effect of annealing is due to the de-activation of iron atoms resulting from their removal from the germanium lattice.

537.311.33

1059. LIFETIME OF NON-EQUILIBRIUM CHARGE CARRIERS IN GERMANIUM FOR ARBITRARY INJECTION LEVELS. M.I.Iglitsyn, Yu.A.Kontsevoĭ and A.I.Sidorov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2461-8 (1957). In Russian.

The dependence of lifetime on concentration of non-equilibrium charge carriers has been investigated at different temperatures for germanium specimens alloyed with antimony. At room temperature, lifetime decreases with increasing injection level for high-resistance specimens and increases for low-resistance specimens. Comparison of the experimental results with the Shockley—Read theory enables the type of levels (donor or acceptor) to be determined, as well as their position in the forbidden band, the energy of ionization and the ratio of the probabilities of capture of electrons and holes. Information may also be obtained regarding the temperature dependence of the cross-sections of capture. A.

537.311.33

1060. MEASUREMENT OF SHORT LIFETIMES OF CHARGE CARRIERS IN GERMANIUM. L.S.Smirnov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2469-71 (1957). In Russian.

Specimens in the form of germanium plates with a p—n junction of large area were used for the measurements. Non-equilibrium carriers were excited by monochromatic light close to the surface of the semiconductor. The lifetime of the charge carriers was calculated from the short-circuit current and the number of light quanta absorbed. Applied to germanium, the method enables lifetimes from 2×10^{-6} to 10^{-8} sec to be measured. The method is suitable for the determination of the temperature dependence of lifetime and the position of the recombination levels.

537.311.33

1061. RESISTIVITY AND HALL EFFECT OF THIN LAYERS OF INDIUM ANTIMONIDE. J.Launey and A.Colombani.
C.R. Acad. Sci. (Paris), Vol. 245, No. 12, 1009-11 (Sept. 16, 1957). In French.

These were measured for layers of 300 A to 3000 A thickness,

reheated after deposition to various temperatures up to 470°C. Semiconducting properties appeared after reheating to about 180°C. Resistivity dropped with increasing layer thickness towards values characteristic of bulk specimens. Hall effect increased with temperature of reheat, and was linear with current for fields up to 35 000 oersted. D.Haneman

537.311.33 : 517.6

INTEGRALS USEFUL IN SEMICONDUCTOR THEORY. See Abstr. 843-5

537.311.33 : 621.315.59

1062. JUNCTION CAPACITANCE AND RELATED CHARACTERISTICS USING GRADED IMPURITY SEMICONDUCTORS. L.J.Giacoletto.
I.R.E. Trans Electron Devices, Vol. ED-4, No. 3, 207-15 (July, 1957).

The transition capacitance of a junction of semiconductors with constant impurity density is well-known and varies inversely with the square root of the bias voltage. The variation of transition capacitance with bias voltage of a junction of semiconductors with graded impurity densities is analysed; i.e., densities which are an arbitrary function of position. It is found that the transition capacitance can be simply related to a depletion width and that, in turn, depletion width can be related to the bias voltage. An analysis is also carried out for the impurity grading to produce a specified transition capacitance variation, as for instance, a linear variation of capacitance with bias voltage. It is also possible to determine impurity gradings to satisfy certain special conditions. An example of this type that is considered in some detail is the determination of the impurity grading which will produce avalanche breakdown simultaneously throughout the semiconductor. An important result of the analysis is that the capacitance v. bias voltage relation can be favourably modified by suitable choice of impurity grading. The practical realization of the various characterisitcs considered is contingent upon techniques for fabricating semiconductors with specified impurity gradings. A.

537.311.33

1063. DISTRIBUTION OF NON-EQUILIBRIUM CHARGE CARRIERS IN THE BASE REGION OF A P–N JUNCTION WITH A HIGH INJECTION COEFFICIENT. M.I.Iglitsyn, Yu.A.Kontsevoĭ and A.I.Sidorov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2458-60 (1957). In Russian.

Solution of a system of equations expressing the steady-state p–n junction action with an arbitrary injection level and lifetime dependent upon the injection level.

537.311.33 : 537.321 : 621.382

1064. THE THERMOELECTRIC TRANSISTOR. A POSSIBLE BATTERYLESS AMPLIFYING SEMICONDUCTOR DEVICE. A.Kelen and P.Svedberg.
Appl. sci. Res. B, Vol. 6, No. 5, 369-78 (1957).

A signal, modulating by carrier emission the concentration of free carriers in a semiconductor wafer containing a temperature gradient, is reproduced by the thermoelectric voltage between output electrodes at different temperatures. The conditions for power amplification are discussed. Criteria are derived for the choice of material, geometrical shape and heat flow through an amplifying device. The use of germanium seems to be possible, though difficult. New semiconducting materials show promising properties. A.

537.311.33 : 535.345.1

EFFECT OF ELECTRIC FIELD ON THE TRANSPARENCY OF A GERMANIUM DIODE. See Abstr. 974

537.311.33 : 537.533

ELECTRON EMISSION FROM SILICON P–N JUNCTIONS. See Abstr. 1090

537.311.35 : 532.14 : 532.133

ELECTRICAL CONDUCTIVITY OF LIQUID TIN AND ZINC ALLOYS. See Abstr. 899

537.312.5

1065. SPECTRAL RESPONSE AND LINEARITY OF PHOTOMULTIPLIERS. H.Edels and W.A.Gambling.
Brit. J. appl. Phys., Vol. 8, No. 12, 481-5 (Dec., 1957).

The spatial variations of the spectral response of type RCA931A photomultiplier tubes were measured by two different methods. The results, in agreement with earlier work, show that the spatial form of the response varies widely with wavelength. It is shown that for experiments utilizing only a restricted portion of the cathode surface errors up to 10% may be made in relative intensity measurements if the calibration and experimental sources do not illuminate the same portion of the cathode area. Other experiments show that the multiplier output varies linearly with input intensity for output currents up to at least 10 μA, if the electrical circuit is suitably designed. A.

537.312.5 : 537.311.33

1066. ON THE SHAPE OF THE SPECTRAL DISTRIBUTION OF PHOTOCONDUCTIVITY OF CdS MONOCRYSTALS. V.E.Lashkarev, E.A.Sal'kov, G.A.Fedorus and M.K.Sheĭnkman.
Dokl. Adad. Nauk SSSR, Vol. 114, No. 6, 1203-5 (1957). In Russian.

The fall in photoconductivity in the region of continuous absorption is shown to be due to a reduction in quantum efficiency arising from exciton annihilation at surface levels. It is not due to changes in carrier lifetime, Hall mobility, or surface reflectance. Observed spectral variations in lifetime are interpreted in terms of changes in carrier concentration. The importance of maintaining constant quantum excitation for measurements of lifetime is stressed. C.H.L.Goodman

537.312.5

1067. NEW INFRA-RED DETECTORS USING INDIUM ANTIMONIDE. D.G.Avery, D.W.Goodwin and A.E.Rennie.
J. sci. Instrum., Vol. 34, No. 10, 394-5 (Oct., 1957).

Describes the properties of InSb detectors, at room temperature, using the photoconductive process, and experimental work on sensitive p–n junction detectors, cooled to 90°K, used as photovoltaic cells. A.

537.312.5

1068. ON THE ELECTRONIC CONDUCTIVITY OF CRYSTALS OF SILVER HALIDES. J.W.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 2, 1276-81 (Oct., 1957).

Crystals of silver halides which have been grown and annealed in air have always been used for measurements of photoconductivity. Such crystals, which are dilute solutions of silver oxide in the silver halide, have a much greater photoconductive response at room temperature than crystals of the highest purity. The mechanism responsible for the sensitization of the photoconductivity by silver oxide is here discussed. The relationship of the model which is proposed to that developed by Newman, Tyler and Woodbury for the interpretation of sensitized photoconductivity in n-type germanium is indicated. A.

537.312.62

1069. JUMPS IN THE DECAY OF CURRENT IN A SUPERCONDUCTING RING. A.A.Galkin, Ya.S.Kan and B.G.Lazarev.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1582 (1957). In Russian.

A ring made of 1 mm diameter lead wire looped into a circle of diameter 1 cm was allowed to warm very gradually (~ 0.1°K per hour) while carrying a persistent current. Jumps of current lasting several seconds were observed from which it could be inferred that an effective resistance of order 10^{-11} ohm appeared from time to time in the ring (the full normal resistance was about 10^{-7} ohm). D.Shoenberg

537.312.8 : 538.632

1070. HALL COEFFICIENT OF TECHNICALLY PURE METALS FROM 80°K TO 800°K. I. RESULTS FOR Cu, Ag, Au, Pd AND Pt. V.Frank.
Appl. sci. Res. B, Vol. 6, No. 5, 379-87 (1957).

The Hall coefficients of Cu, Ag and Au are very similar in their temperature dependence, exhibiting (numerically) a flat minimum at about 200°K, a slow rise at high temperatures and a more rapid rise at low temperatures. The variation is within 10-15% of the room temperature value, which is 3 to 5 times the variation caused by thermal expansion on the basis of a one-band model. For Pd and Pt a sharp minimum is found, and the variation on the high temperature side is strong (at variance with older work for Pt). This is tentatively ascribed to a thermal shift of the Fermi surface, possible in view of the low degeneracy temperature of these metals. A.

537.312.8 : 538.632

1071. HALL COEFFICIENT OF TECHNICALLY PURE METALS FROM 80°K TO 800°K. II. RESULTS FOR Zr, W, Mo, Ta, Nb, AND Al. SURVEY OF RESULTS FOR THE 4d- AND 5d-TRANSITION GROUP OF METALS. V.Frank.
Appl. sci. Res. B, Vol. 7, No. 1, 41-51 (1958).

The Hall coefficients (R_H) of W, Mo, Ta and Nb are all positive; they are practically independent of temperature for Mo, Ta and Nb, whereas R_H for W rises linearly with T for high T. R_H for Zr is positive and exhibits a maximum at 250°K with a strong decrease on the high temperature side. R_H for Al is negative, increasing (numerically) with T in the whole temperature range. Surveying

existing data it becomes clear that there is no simple correspondence between the temperature variation of R_H and the behaviour of the specific resistance at high temperatures or the electronic structure of the metal. The variation of r_H (= $R_H eN$, where e = electron charge, N = number of atoms per unit volume) with the number of conduction electrons is (neglecting all finer details) regular, exhibiting a positive peak ($r_H \cong 2.5$) in the middle of the d-band for all three transition groups; interpretation in terms of a two-band model does not seem feasible. A.

ELECTRIC DISCHARGES

537.521

1072. DIPOLES AND ELECTRIC BREAKDOWN.
J.A.Kok and M.M.G.Corbey.
Appl. sci. Res. B, Vol. 6, No. 6, 449-55 (1957).

It is shown that breakdown of insulating or dielectric material may be caused either by polarizable particles or permanent dipoles. Induced dipoles as well as permanent dipoles may gather at a place of maximum stress and form a bridge. Bridges consisting of permanent dipoles may cause the gap between the valence energy band and the conduction energy band to be filled by impurity or imperfection levels. The low ionization potentials of electrons attached to permanent dipoles may facilitate brakdown. An attempt is made to reconcile Crowe's results (Abstr. 2779/1955) with ours. A.

537.521

1073. IONIZATION PHENOMENA IN GASES.
W.R.S.Garton and R.Latham.
Nature (London), Vol. 180, 790-4 (Oct. 19, 1957).

An informal report of the proceedings of the Third International Conference on Ionization Phenomena in Gases, organized by the Societa Italiana di Fisica in Venice, June, 1957. A total of some 130 papers were presented, the full texts of which are only available in a limited number of mineographed copies distributed by the Societa (Milano, Via Saldini 50). The subjects covered by the conference included: (1) Fundamental collision processes; (2) Spark breakdown; (3) Channel and electrode phenomena in arcs; (4) Glow discharge phenomena; (5) Counters; (6) Plasma theory; (7) High-temperature plasma and pulse discharges, including electromagnetic pinch effects and relevance to controlled thermonuclear fusion. Particular emphasis was given to the last subject.

537.521 : 539.2

1074. A VARIATIONAL CALCULATION OF THE EQUILIBRIUM PROPERTIES OF A CLASSICAL PLASMA. S.F.Edwards.
Phil. Mag. (Eighth Ser.), Vol. 3, 119-24 (Feb., 1958).

A variational calculation is given for the free energy of a fully ionized classical plasma. The method avoids redundant variables and allows for cross terms between collective and individual modes of oscillation, though these turn out to be small. A relation is given for the shielding distance in terms of the Debye–Hückel radius and the interparticle distance, it being of the order of the former. A.

537.523.5 : 538.69

1075. ARC MOTION WITH MAGNETIZED ELECTRODES.
A.E.Guile, T.J.Lewis and S.F.Mehta.
Brit. J. appl. Phys., Vol. 8, No. 11, 444-8 (Nov., 1957).

The velocities of d.c. arcs moving in air at atmospheric pressure between horizontal and parallel cylindrical electrodes were measured. The arcs moved freely in straight regular tracks in an axial direction under the action of magnetic fields set up by the current flow in the electrodes. Ferrous and non-ferous electrodes were used and it was found that the axial velocity increased with the current in all cases, but was very much greater in magnitude for the steel electrodes. The hypothesis that the magnetic properties of the steels were responsible for the higher velocities was tested by magnetizing these materials in the axial direction along the electrodes. The cathode and anode spots then described helical paths with the anode moving in an opposite sense to the cathode, the circumferential component of the velocity being provided by the axial flux. It was deduced that magnetic fields within the electrode surfaces determined the motion. It is suggested that transverse galvanomagnetic and thermomagnetic forces modify the electron emission and are responsible for the cathode motion. It appears that these forces also influence the motion of the anode spot. A.

537.525 : 537.562

1076. PREFERENTIAL IONIZATION OF ARGON IN THE PRESENCE OF AIR AND ITS APPLICATION TO ELECTRIC DISCHARGE DEVICES. D.P.C.Thackeray.
Nature (London), Vol. 180, 913-14 (Nov. 2, 1957).

Photographs show that pulsed discharges (of the sort suitable for use as sources of illumination for high-speed-photographic recording) may be confined to a desired and repeatable path between the electrodes by means of an axial non-turbulent flow of argon. Characteristics of the light pulse from such a discharge are given. J.Dutton

537.525 : 539.18

1077. ON THE CONCENTRATION OF EXCITED ATOMS IN NEON AND CADMIUM DISCHARGES. N.P.Penkin.
Optika i Spektrosk., Vol. 2, No. 5, 545-56 (1957). In Russian.

The positive-column discharge in cadmium with argon, pure neon and neon with mixtures of other inert gases, were studied successively both by optical dispersion ("hooks") and probe methods. The population in the Cd levels 5^3P_2 and $5^3P_{0,1}$ show one and two maxima respectively for argon pressures between 0.1 and 4 mm Hg. Relative f-values for terms with the lower levels $5^3P_{0,1,2}$ were determined. Concentrations of metastable neon atoms determined by the hooks method and by calculation from the electron temperature differs by the order of 1000 and there is therefore no equilibrium in the discharge. Argon, krypton and xenon even when introduced in low concentrations (~ 1%) into neon discharge, unlike He, decrease the population in the metastable level $^3P_2$. The probability of ionizing argon by metastable neon atoms was shown to be 0.07. L.Bovey

537.525 : 539.19

1078. THE DECAY OF THE NITROGEN AFTERGLOW.
J.M.Anderson, A.D.Kavadas and R.W.McKay.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 877-86 (Dec., 1957).

Accurate measurements of the decay of intensity of the nitrogen afterglow were made over a range of intensity greater than 10^6 to one. Electronic methods of gating and control permitted more acurate and reproducible measurements than any previously published. Series of observations are recorded for independent variation of temperature, pressure and oxygen impurity. All curves show three sections whose parameters vary independently of one another, an initial bimolecular decay, a second bimolecular decay and a final logarithmic decay when the glow is very faint. Constants of these processes are derived from graphs shown. Analysis of results is given by Anderson (see abstract following). A.

537.525 : 539.19

1079. THE NATURE OF ACTIVE NITROGEN. J.M.Anderson.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 887-99 (Dec., 1957).

It is shown that the first bimolecular process found experimentally in the decay of the nitrogen afterglow requires oxygen as a catalyst and draws both active bodies from a common population. An activation energy of 900 cm^{-1} is necessary for this afterglow process. The second bimolecular process involves two active bodies possessing monomolecular decays and drawn from different populations. Negligible activation energy is required for this afterglow process. This process is quenched by oxygen and requires a minute impurity believed to be hydrogen. The final monomolecular decay shows the usual diffusion–collision pressure dependence at higher temperatures and effectively diffusion dependence only at lower temperatures. The effects of diffusion are much reduced by a monomolecular layer of oxygen on the walls. An aggregate possessing a dissociation energy of 5600 cm^{-1} is involved in the final afterglow process. Reasons are given for believing that the first bimolecular process is recombination of nitrogen atoms in the presence of an oxygen molecular catalyst of the order of a few parts per million and that the second process is a collision of two different vibrationally excited ground states of the nitrogen molecule with a molecular hydrogen catalyst of the order of a few parts per million. A.

537.525.5 : 538.63

1080. DOPPLER SLANT LINES OBSERVED IN AN AXIAL DISCHARGE IN A MAGNETIC FIELD.
J.R.McNally, Jr and M R.Skidmore.
J. Opt. Soc. Amer., Vol. 47, No. 9, 863-4 (Sept., 1957).

Describes a spectroscopic study of high-intensity arcs used in large electromagnetic separators (calutrons). Details of the source are given. An effect is observed ("slant lines") in the spectra which suggests ordered ionic rotation about the arc column. Ionic velocities were deduced spectroscopically and gave a maximum value of about 2×10^6 cm/sec. J.D.Craggs

537.525.5

1081. ON THE MEASUREMENT OF THE CONCENTRATION OF Na ATOMS IN THE COLUMN OF AN ARC DISCHARGE. V.N.Kolesnikov and L.G.Pokhil'ko.
Optika i Spektrosk., Vol. 2, No. 6, 689-94 (1957). In Russian.

The method of Prilezhaeva, whereby the concentration of easily ionized atoms in plasmas can be determined from intensity measurements on two lines, is discussed from both theoretical and practical aspects. Previous work by others is summarized. Intensities of Na lines and CN bands from a discharge between graphite electrodes (one of which is loaded with various concentrations from 1 to 50% of NaCl) have been measured and estimates of concentrations made. Errors inherent in the method are given and ways to reduce them discussed. L.Bovey

537.528

1082. THE BREAKDOWN OF LIQUID DIELECTRICS AND ITS DEPENDENCE ON OXIDATION OF THE ELECTRODES. R.Hancox.
Brit. J. appl. Phys., Vol. 8, No. 12, 476-80 (Dec., 1957).

The dependence of the impulse breakdown strength of a liquid dielectric on the natural oxide layer on the electrodes used for the test is considered. It is shown that an electric field may exist in the oxide layer owing to the chemisorption of oxygen, and that this would be expected to reduce the probability of electron emission from the cathode and thus increase the recorded breakdown strength. Results are given of experiments on the breakdown of pretreated transformer oil using stainless steel, brass, and aluminium electrodes which support this conclusion. A.

X-RAYS

537.531 : 535.33

1083. A STUDY OF THE L SPECTRA OF PALLADIUM. C.Bonnelle and C.Mande.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2253-6 (Dec. 16, 1957). In French.

The L spectrum of palladium was investigated using a vacuum spectrometer provided with a bent quartz crystal. The dispersion was 5.4 eV/mm in the neighbourhood of the L_{III} absorption-edge. The emission band $L\beta_2$ was re-determined and the absorption coefficient obtained in the L_{III} region. The results are compared with those of previous workers. T.Mulvey

537.531 : 535.3 : 539.234

1084. REFLECTION OF X-RAYS FROM CONDENSED METAL FILMS. L.M.Rieser, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 11, 987-94 (Nov., 1957).

The results of a series of measurements on the X-ray reflectivity of metal films evaporated on a glass substrate are presented. Comparison of these results with theory is made and the necessity of making measurements on bulk material is pointed out if the disagreements with theory are to be eliminated. A.

537.531.7 : 537.533.74 : 539.19

1085. X-RAY AND ELECTRON SCATTERING BY MOLECULAR HYDROGEN. C.Carter, N.H.March and D.Vincent.
Proc. Phys. Soc., Vol. 71, Pt 1, 2-16 (Jan., 1958).

A theoretical study has been made of the X-ray and electron scattering to be expected from molecular hydrogen. The methods of calculation have the common feature that they are based on expansions of the wave-function, density and potential in Legendre polynomials. Simple self-consistent field wave-functions having spherical symmetry are presented and, while the binding energy thereby obtained is poor, it is found nevertheless that they may be utilized with success in both the X-ray and the electron scattering calculations. The X-ray scattering is also discussed on the basis of an LCAO molecular-orbital function and the "floating" function of Gurnee and Magee. It is found that the results of the various approximations used agree well among themselves and also with experiment, and some conclusions regarding the charge distribution in the hydrogen molecule may be drawn. For the elastic scattering of slow electrons, it is found that there is good agreement between the present results and earlier work of Massey and Ridley if exchange is neglected in both cases. However, it is found that electron exchange markedly affects the scattering cross-sections, thus confirming the essential conclusions of Massey and Ridley, although the method employed in the present work is probably not sufficiently reliable to enable the precise effect of exchange to be determined. A.

CATHODE RAYS. POSITIVE RAYS

537.533

1086. ABOUT DAMPING AND ANTIDAMPING BETATRON OSCILLATIONS, TAKING INTO ACCOUNT NON-ADIABATIC PROPERTIES OF THE RADIATION. A.N.Matveev.
Nuovo Cimento, Vol. 6, No. 6, 1296-304 (Dec., 1957).

Radiation effects on operation of high-energy electron synchrotrons are discussed. It is shown that there exist neither a damping nor an antidamping of betatron oscillations due to radiation. Accelerating cavities are taken into account with the aid of difference equations. The equation for betatron oscillations is presented taking account of the radiation and all kinds of accelerating fields. The lifetime of adiabatic invariants is calculated. A.

537.533

1087. ELECTRON MOTION IN SYNCHROTRONS IN THE PRESENCE OF RADIATION. A.N.Matveev.
Nuovo Cimento, Vol. 6, No. 6, 1305-17 (Dec., 1958).

The effect of radiation fluctuations on electron motion in synchrotrons is discussed. A stochastic theory of betatrons and phase oscillations, induced by radiation fluctuations, is presented. A.

537.533 : 537.534 : 538.561

1088. LONGITUDINAL OSCILLATIONS OF ELECTRON—ION BEAMS. R.V.Polovin and N.L.Tsintsadze.
Zh. tekh. Fiz., Vol. 27, No. 11, 2615-23 (1957). In Russian.

It is known that an electron—ion beam can exist in the case where the density of the electrons is not equal to the density of the ions. The beam will exist only if the electromagnetic forces acting on the beam are directed towards the centre of the latter. This gives rise to a fluctuation in density resulting in an electromagnetic wave being propagated along the beam. The problem of the stability of such a beam is solved qualitatively by a method not requiring solution of the differential equations involved.

537.533

1089. COMPENSATION OF THE SPACE CHARGE OF AN ELECTRON BEAM. V.I.Volosok and B.V.Chirikov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2624-30 (1957). In Russian.

The compensation of the space charge of an electron beam by ions, formed by ionization of the residual gas, has been studied. The investigation was carried out under pulsed conditions by measuring the electric field of the space charge of the beam. It is found that a virtual cathode exists for a certain time in the beam. A qualitative explanation is given for the observed phenomena.

537.533 : 537.311.33

1090. ELECTRON EMISSION FROM SILICON P—N JUNCTIONS. J.Tauc.
Nature (London), Vol. 181, 38 (Jan. 4, 1958).

A preliminary note. With a Geiger counter at 2000 V, distant several mm in air from a silicon p—n junction, some electron emission was observed when breakdown current flowed in the reverse direction. D.Haneman

537.533.2

1091. ELECTROSTATIC ELECTRON EMISSION OF SEMICONDUCTORS. I.I.Gofman, B.G.Smirnov, G.S.Spirin and G.N.Shuppe.
Zh. tekh. Fiz., Vol. 27, No. 11, 2662-3 (1957). In Russian.

An investigation of the field emission from a carbided tungsten tip shows that the characteristic of emission current plotted against potential is in agreement with theory.

537.533.35

1092. ON THE SCREEN BRIGHTNESS REQUIRED FOR HIGH RESOLUTION OPERATION OF THE ELECTRON MICROSCOPE. A.W.Agar.
Brit. J. appl. Phys., Vol. 8, No. 10, 410-13 (Oct., 1957).

To determine the relationship between the screen brightness and the regularly obtainable resolution, the screen brightness, measured by a S.E.I. photometer was plotted against the minimum width of Fresnel fringe which was clearly visible all round a circular hole in a carbon film. It was found that there is an optimum fringe width at which the brightness is used most economically. It is also shown that unless the brightness exceeds a certain value (for a given resolution) it is not possible to be certain that this resolution can be attained. A.

537.533.35 : 537.311.33

1093. THE EXAMINATION OF P–N JUNCTIONS WITH THE SCANNING ELECTRON MICROSCOPE.
C.W.Oatley and T.E.Everhart.
J. Electronics, Vol. 2, No. 6, 568-70 (May, 1957).

Since the operation of the scanning electron microscope depends on secondary electron emission from the specimen, the position of a p–n junction should be clearly defined, when a reverse bias is applied, by a sharp change of brightness. This was found to be the case, a grown Si junction being employed. J.Thewlis

537.533.35 : 539.165.07

1094. CALCULATION OF THE RAY PENCILS IN A RING FOCUS β-RAY SPECTROMETER. (THEORY OF THE β-SPECTROMETER WITH TWO THIN LENSES. I). W.Schneider.
Z. InstrumKde, Vol. 65, No. 6, 103-6 (June, 1957). In German.

The disadvantages associated with theoretical treatment of the β-ray spectrometer by various authors is briefly reviewed. The present treatment leads to an expression for resolving power directly in terms of parameters that are known to be important in practice. Ray paths are calculated for two bell-shaped fields with special reference to the ring-focus arrangement with a source of finite size. T.Mulvey

537.533.35 : 539.165.07

1095. CALCULATION OF THE OPTICAL PROPERTIES OF THE RING-FOCUS β-SPECTROMETER. (THEORY OF THE β-SPECTROMETER WITH TWO THIN LENSES. II). W.Schneider.
Z. InstrumKde, Vol. 65, No. 7, 126-9 (July, 1957). In German.

A figure of merit is proposed by which the optical efficiency of a β-ray spectrometer may be judged. This is used in conjunction with the trajectories calculated in Pt I (see preceding abstract) to assess the performance of a ring-focus β-ray spectrometer. T.Mulvey

537.533.7 : 538.114

EFFECT OF MAGNETIC DOMAINS IN COBALT ON AN ELECTRON BEAM. See Abstr. 651

537.534 : 621.319.339

1096. ENERGY STABILIZATION OF AN ELECTROSTATIC ACCELERATOR. B.Millar, R.Bailey and J.L.W.Churchill.
J. sci. Instrum., Vol. 34, No. 10, 383-90 (Oct., 1957).

The energy of the ion beam from the accelerator is measured and stabilized with an accuracy of better than 0.1%. The main energy measuring device is an electrostatic analyser which is energized from a stabilized power supply whose voltage is referred to standard cells. A generating voltmeter is used an as auxiliary measuring device, and a method is described by which a very fast response may be obtained from this instrument. An electron beam loading the generator is used as a fast acting control device, while long term variations are taken up by automatic control of the spray current. A.

537.534

1097. SECOND-HARMONIC ACCELERATION IN THE CYCLOTRON.
K.E.A.Effat and J.H.Fremlin.
J. sci. Instrum., Vol. 34, No. 10, 415-17 (Oct., 1957).

It is shown that steady acceleration is possible in the cyclotron, for ions which take an even number of radiofrequency cycles for one revolution, if the centre of revolution is to one side of the dee gap. The acceleration of HD^+ ions, taking two radiofrequency cycles to complete one revolution, was observed and confirmed by several methods. The contribution of this process to the production and acceleration of multiply charged heavy ions is discussed. A.

537.534.3

1098. THEORY OF THE ABERRATIONS IN THE FOCUSING PROPERTIES OF A MAGNETIC FIELD WITH ONE PLANE OF SYMMETRY. A.J.H.Boerboom.
Appl. sci. Res. B, Vol. 7, No. 1, 52-62 (1958).

A general theory is given of the aberrations in focusing properties occurring in fields with one plane of symmetry. It appears that line to line imaging is possible and that ten geometrical aberrations of the second order exist, together with five chromatic aberrations. Names for these aberrations are proposed. The beam intensity distribution in the image is calculated. A.

537.534.3

1099. AN ION-OPTICAL BENCH FOR THE STUDY OF MAGNETIC QUADRUPOLE LENSES AND DEFLECTORS FOR PARTICLE ACCELERATORS. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1406-9 (Oct. 21, 1957). In French.

Magnetic quadrupole lenses for focusing and deflecting high-energy nuclear particles have long focal lengths and large apertures, conditions not normally encountered in classical electron optics and which make accurate calculations difficult. An optical bench was therefore devised to study the properties of these lenses experimentally. A beam of ions is formed into a hollow cone by means of a rotating deflector field. The beam is then focused by the quadrupole lens. The image, which is formed on a fluorescent screen, may be observed visually or photographed by an external camera, and the aberrations evaluated. A.E.I. Research Laboratory

537.534.3

1100. AN EXPERIMENTAL STUDY OF THE SPHERICAL ABERRATION OF A SYSTEM OF TWO MAGNETIC QUADRUPOLE LENSES. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1905-8 (Nov. 25, 1957). In French.

The aberrations of a system of two magnetic quadrupole lenses were investigated experimentally using the electron optical bench described in the preceding abstract. The lenses were 15 cm long and spaced 50 cm apart. The lens aperture was 4.0 cm. Accurate calculation of such a system is not feasible owing to the complex end-effects of the magnetic circuit. In addition, the effective length of the lens decreases with increasing ray height. This leads to a negative spherical aberration. The experimental results show that such a quadrupole system of short focal length has a spherical aberration comparable with the best classical round lenses. It should be possible to correct the spherical aberration of the system by introducing positive spherical aberration by suitably altering the field distribution in one of the quadrupoles.

A.E.I. Research Laboratory

537.534.3

1101. PRECISE MEASUREMENT OF ISOTOPE RATIOS WITH A SINGLE COLLECTOR MASS SPECTROMETER.
J.Schutten, A.J.H.Boerboom, T.v.d.Hauw and F.Monterie.
Appl. sci. Res. B, Vol. 6, No. 5, 388-92 (1957).

A simple electronic circuit is described, making possible a precise determination of isotope ratios measured with a single-collector mass spectrometer. For C^{13}/C^{12} measurements an accuracy of better than 0.1% is obtained, corresponding to an absolute sensitivity of better than $1 : 10^5$. A.

537.534.75

1102. A "CLASSICAL" DEMONSTRATION OF BETHE'S STOPPING-POWER FORMULA IN THE NON-RELATIVISTIC CASE.
M.Bayet.
J. Phys. Radium, Vol. 18, No. 5, 361 (May, 1957). In French.

Similarity of Bethe's and Bohr's stopping-power formulae when the velocity v of the incident particle is small enough to neglect v^4/c^4, suggests a new classical approach. This is made, with the introduction of a semi-empirical characteristic energy for the scattering atoms, and leads to Bethe's formula except for very low velocities. J.Hawgood

537.534.75 : 539.12

1103. THE STOPPING OF LOW-ENERGY ATOMIC PARTICLES.
M.Bayet.
J. Phys. Radium, Vol. 18, No. 6, 413-14 (June, 1957). In French.

The "classical" formula (see preceding abstract) which differs from Bethe's only for low energies is tested by an experiment of stopping low-energy protons and alpha-particles by H_2 gas. It can represent experiment fairly well if the effective charge of the incident particle is made to tend to zero with the velocity.

J.Hawgood

DISCHARGE TUBES. IONIZATION. THERMIONICS

537.542

1104. SPECTRAL SENSITIVITY OF NEON DISCHARGE TUBES.
T.J.Dillon.
Brit. J. appl. Phys., Vol. 8, No. 12, 490-2 (Dec., 1957).

The relative photoresponse of certain types of neon discharge tubes to irradiation at different wavelengths was investigated by spectrophotometric methods. The experimental results, using a large number of discharge tubes, are expressed graphically as relative photoresponse for equal energy of incident radiation plotted against wavelength. The curves show that the discharge tubes act like photoemissive cells with caesium alloy cathodes. It is suggested that the photosensitivity is due to the positive Joshi effect as well as to the presence of caesium on the tube electrodes. A.

537.543 : 621.385.3

1105. PERTURBATION ANALYSIS OF STATIONARY DENSE ELECTRON FLOW AND A SPACE-CHARGE-LIMITED TRIODE. G.A.Stuart and B.Meltzer.
J. Electronics and Control, Vol. 3, No. 1, 51-62 (July, 1957).

The first-order perturbation of stationary dense electron flow is analysed for three cases of rectilinear flow: those of planar, cylindrical and spherical symmetry. The differential equations for the perturbed parts of the action function are linear and separable. The general solution is obtained for the planar case, with space-charge limitation (perturbation of Child–Langmuir flow), and applied to a positively biased planar triode to obtain the amplification factor, mutual conductance, etc. B.Meltzer

537.562

1106. ON THE HYDRODYNAMICS OF AN ELECTRON GAS. F.Möglich.
S.B. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech., 1956; publ. 1957, No. 1, 29 pp. In German.

An advanced theoretical treatment of the hydrodynamical properties of an electron gas (continuity equations, etc.) following the work of Kronig (see for example Abstr. 6481/1952 on a collective description of electron interaction). J.D.Craggs

537.564

1107. RELATIVISTIC INCREASE OF ENERGY LOSS BY IONIZATION IN GASES. R.G.Kepler, C.A.d'Andlau, W.B.Fretter and L.F.Hansen.
Nuovo Cimento, Vol. 7, No. 1, 71-86 (Jan. 1, 1958).

Measurements of ionization loss by relativistic charged particles were made in helium, argon and xenon. The experimental results agree well with theory in the case of helium. In argon, and particularly in xenon, the relativistic rise in ionization found experimentally is less than that predicted theoretically. The measurements were made by the method of counting drops in a cloud chamber. A.

COSMIC RAYS

537.591.1.08

1108. MEASUREMENTS OF THE SOFT COMPONENT OF COSMIC RADIATION BY AN ABSORPTION "WELL METHOD". A.W.Manning.
J. atmos. terrest. Phys., Vol. 10, No. 4, 189-93 (1957).

To measure the soft component of cosmic radiation, which is defined as that part of the total radiation absorbed in 10 cm of Fe, an absorption "well method" originally proposed by Hess (1953) was used. This method employs the procedure of taking measurements with the ionization chamber placed so that the top of the chamber was even with the absorbing sides of an iron house and then repeating the same procedure with the chamber "sunk" into the iron house to a depth of one-half of its height. The difference in the solid angle of exposure in the two positions makes it possible to compute the ionization resulting from the soft component plus the gamma rays from the decay products of radon and thoron in the atmosphere. The results of these experiments indicate an ionization ten times greater than the theoretical value of the radiation from the radioactive products in the atmosphere, as computed by Hess (1943). A.

537.591.15

1109. ANALYSIS OF BURSTS PRODUCED BY MESONS. M.R.Gupta.
Nuovo Cimento, Vol. 7, No. 1, 39-52 (Jan. 1, 1958).

The contributions made by the μ and π^0-mesons to the frequency of burst production under a thick shield of materials are calculated by making use of the recent results of the soft cascade shower theory. The theoretical results thus obtained are compared with the observational data given by various authors. Satisfactory agreements between the theoretical and observational results are found everywhere, at high altitude, at sea-level and also underground, using Poisson's distribution for the fluctuation, and taking $\bar{N}(E = 2mc^2, t)$, as the average number of particles in a shower. Further it is seen that the burst calculations made with the above modifications lead unambiguously in favour of the ½ spin theory of the μ-meson, in contradistinction to the uncertainties met with previously while trying to determine the spin of the μ-meson from the observed burst rates. The effects of taking $N(E = 0, t)$ for the average number of particles in a shower or of using a Furry distribution for the fluctuation, are also estimated. A.

537.591.15

1110. ARRIVAL DIRECTIONS OF COSMIC RAY AIR SHOWERS FROM THE NORTHERN SKY. G.W.Clark.
Phys. Rev., Vol. 108, No. 2, 450-7 (Oct. 15, 1957).

The celestial arrival directions of 2660 air showers of size greater than 10^5 particles at sea level were determined with an angular resolution of 4°. The observations were made by the method of fast timing, and they cover a band of declination from 10° to 90° north. No significant deviation from isotropy of the primaries of these showers was found. The response of the array to showers of various sizes and arrival directions is evaluated theoretically and the results are given. The zenith-angle dependence of the counting rate indicates an exponential attenuation with atmospheric depth of the intensity of showers at sea level with an attenuation length of 107 ± 11 g.cm^{-2}. As a by-product of the experiment a value was found for the absolute intensity of showers of size greater than 10^5 particles in the vertical direction at sea level which is $(9.6 \pm 3.0) \times \times 10^{-11}$ cm^{-2}.sec^{-1}.sterad^{-1}. A.

537.591.2

1111. ON THE CORRECTION OF THE INTENSITY OF COSMIC RAYS AT SEA LEVEL BY MEANS OF ATMOSPHERIC DATA. U.Fasoli and J.Pohl-Rüling.
Nuovo Cimento, Vol. 6, No. 6, 1339-55 (Dec., 1957).

Various correlations are investigated between the total intensity of cosmic rays and the meteorological factors of the atmosphere. These measurements were carried out at Padua using three different sets of apparatus. An analysis is made of the atmospheric data, and the effect of the seasonal variation on the correlation coefficients is discussed. A.

537.591.5

1112. THE 24 HOUR INTENSITY VARIATIONS OF THE PRIMARY COSMIC RAYS. A.M.Conforto and J.A.Simpson.
Nuovo Cimento, Vol. 6, No. 5, 1052-63 (Nov., 1957).

The data from nucleonic component detectors (neutron intensity monitors) are analysed for the amplitude and phase of maximum intensity of the 24 hr variation at the geomagnetic equator and at 48°N. The same analysis is performed on selected charged particle detectors. The analysis covers 1953-55, which includes the time of solar cycle (sunspot) minimum in 1954. During 1954 it is known that the 24 hr variation possesses an anomalous behaviour. It is shown that during 1954 there is an interval of 9 months or more when the solar daily variation appears to undergo a progressive phase-shift whose time of maximum lies in the range of 08 00–10 00 hr on a sidereal time scale. This anisotropy certainly exists in the radiation falling upon the atmosphere, and it is likely, although not proven, that the anisotropy prevails even outside the terrestrial field. The question of whether this sidereal effect is spurious or real is discussed in relationship to the recent results on the modulation of cosmic-ray intensity within the solar system. A.

537.591.5

1113. TIME VARIATIONS OF THE COSMIC RAY INTENSITY IN JAMAICA. J.C.Barton and J.H.Stockhausen.
Phil. Mag. (Eighth Ser.), Vol. 3, 55-62 (Jan., 1958).

A three-fold counter telescope was used to study the radiation penetrating 10 cm of lead at a latitude of 18°N. A barometric coefficient of $-0.14 \pm 0.02\%$ per millibar was deduced from the semi-diurnal variation. The average counting rate decreased on days of high geomagnetic activity and at the same time there was a large increase in the diurnal variation. A.

537.591.5

1114. HIGH-ALTITUDE INTENSITIES OF THE MEDIUM AND HEAVY COSMIC-RAY NUCLEI AND OF THE STAR-PRODUCING COMPONENT OVER A 25-HOUR INTERVAL. R.F.Missert.
Phys. Rev., Vol. 108, No. 5, 1327-30 (Dec. 1, 1957).

Results are reported on a study of the hourly averaged values of intensity of medium and heavy cosmic-ray nuclei and of the star-producing component over a day and night interval, at an average atmospheric depth of 15 g/cm^2. The equipment was carried aloft by a Skyhook balloon in 1954 from Minneapolis, Minnesota (geomagnetic latitude 55°N). A large, thin-walled spherical pulse-ionization chamber served as the detecting instrument. Approximately 125 000 of these cosmic-ray events were recorded over the 25-hour flight interval; thus, statistical counting rate fluctuations were reduced substantially below those previously attained in this field. Analysis shows that approximately one-half of the counting rate at 15 g/cm^2 can be ascribed to the medium and heavy nuclei, the remainder being reasonably accounted for as arising from the star-producing component. No variation is observed in the hourly averaged counting

rate of pulses of size greater than 6 MeV throughout the flight, to within the combined statistical and experimental uncertainties of ±4 to 6% during the daytime, and ±8 to 10% during the night. A.

537.591.5

1115. GEOMAGNETIC EFFECTS ON HEAVY PRIMARY COSMIC RADIATION AT 42°N. R.E.Danielson and P.S.Freier.
Phys. Rev., Vol. 109, No. 1, 151-7 (Jan. 1, 1958).

The zenith and azimuthal angular distribution of primary cosmic-rays with charges $Z \geq 5$ was measured at Texas using horizontal emulsions with known orientation relative to the earth. The magnitude of the azimuthal asymmetry is consistent with Störmer theory down to a zenith angle of about 65° while for larger zenith angles the effect of the solid earth (shadow cone) is observed. The direction of the asymmetry seems to be consistent with the centred dipole approximation of the earth's magnetic field (north pole at 79°N and 70°W). The flux at the top of the atmosphere is 1.6 ± 0.3 particles/m².sec.sterad for nuclei with $Z \geq 10$ and 4.8 ± 1.0 particles/m².sec.sterad for C,N,O,F nuclei. A.

537.591.8

1116. THE FORMATION OF ^{22}Na FROM ATMOSPHERIC ARGON BY COSMIC RAYS. L.Marquez, N.L.Costa and I.G.Almeida.
Nuovo Cimento, Vol. 6, No. 6, 1292-5 (Dec., 1957).

It was found that Na^{22} is formed as a spallation product of atmospheric argon by cosmic rays. It was isolated from the fresh rainwater of Rio de Janeiro, and its average activity is 0.017 d.p.m./litre. A.

537.591.8 : 539.12

1117. ON THE NUCLEON–NUCLEON INTERACTION WITH ENERGY HIGHER THAN 10^{14} eV.
P.Ciok, M.Danysz, J.Gierula, A.Jurak, M.Mięsowicz, J.Pernegr, J.Vrána and W.Wolter.
Nuovo Cimento, Vol. 6, No. 6, 1409-15 (Dec., 1957).

A jet $0 + 14\alpha$ of energy 3.3×10^{14} eV is described. It was found that the distribution of charged particles is asymmetric in the centre-of-mass system but becomes symmetric when the neutral particles have been taken into consideration. The information about the neutral particles was obtained from the development of the electronic component of the shower. The angular distribution in the centre-of-mass system is strongly anisotropic and near to Heisenberg's distribution. The energy of the secondary particles in the centre-of-mass system is of the order of a few GeV and transversal momenta given for two secondaries are of the order of several hundred MeV/c. The inelasticity coefficient is ~0.1. A.

537.591.8

1118. THE AVERAGE MULTIPLICITY AND INELASTICITY IN π-MESON PRODUCTION IN THE ATMOSPHERE.
G.Ishikawa and K.Maeda.
Nuovo Cimento, Vol. 7, No. 1, 53-66 (Jan. 1, 1958).

The energy spectra of primary and secondary cosmic radiation are analysed to find the multiplicity–energy relation in the π-meson production in the atmosphere at the energy region from several GeV to some thousands GeV with the help of simplified considerations on the meson production by nucleus–nucleus collisions. The results being subjected to the assumed values of inelasticity suggest that the multiplicity–energy relation agrees with the formula of the type given by Fermi and Landau under the condition of a practically constant small inelasticity. A.

537.591.8

1119. ATMOSPHERIC SIGNALS CAUSED BY COSMIC-RAY SHOWERS. R.R Wilson.
Phys. Rev., Vol. 108, No. 1, 155-6 (Oct. 1, 1957).

It is suggested that large cosmic-ray showers can be detected by the electrical signal produced when the ionization of the shower nullifies the electric field of the earth. The signal should have two components, a very short but small signal due to the motion of free electrons, and a slow but possibly large component due to the motion of the ions. The energy of the signal is stored in the earth's electrical field until it is released by the ionization. An estimate is made of the size and duration of the signals which indicates that they may be detectable, especially in the case of the slow signal which may have a time of rise of the order of a fraction of a second. A.

MAGNETISM

538.11

1120. SECOND-NEAREST-NEIGHBOR NUCLEAR MAGNETIC RESONANCE SHIFTS IN IRON GROUP PHOSPHATES. J.M.Mays.
Phys. Rev., Vol. 108, No. 4, 1090-1 (Nov. 15, 1957).

Studies of the P^{31} resonance established shifts suggesting antiferromagnetic or ferromagnetic transitions. In $LiMnPO_4$ the shift of the P^{31} resonance (~ 65 gauss) is attributed to the magnetization of the non-adjacent Mn^{++} ion acting through electron transfer. The width of the line (~ 2 gauss) is due to exchange-narrowed hyperfine interaction. The Li^7 resonance, split by quadrupole interactions showed a much smaller shift due to simple paramagnetic effects. A sharp antiferromagnetic transition was observed at 41.5°K. Shifts and Néel temperatures of other phosphates are tabulated. D.J.Oliver

538.11

1121. DORFMAN'S PROPOSAL REGARDING CYCLOTRON RESONANCE IN FERROMAGNETIC SUBSTANCES. C.Kittel.
Phys. Rev., Vol. 108, No. 4, 1097-8 (Nov. 15, 1957).

Suggests that, since the spin–orbit interaction in ferromagnetics cannot be described by an effective magnetic field the effect predicted by Dorfman (Abstr. 3426/1957) may not exist. D.J.Oliver

538.113

1122. HARTREE–FOCK VALUES OF DIAMAGNETIC SUSCEPTIBILITIES OF NEON-LIKE IONS. S.Kobayashi.
J. Phys. Soc. Japan, Vol. 12, No. 6, 737 (June, 1957).

The calculated values for the ions F^-, Ne, Na^+, Mg^{2+}, Al^{3+}, Si^{4+} are compared with those based on the T.F.D. approximation. Differences are found, especially if the degree of ionization is low. E.P.Wohlfarth

538.114

1123. NUCLEAR RELAXATION BY THE HYPERFINE INTERACTION WITH THE ION CORE SPINS IN FERROMAGNETIC AND ANTIFERROMAGNETIC CRYSTALS. A.H.Mitchell.
J. chem. Phys., Vol. 27, No. 1, 17-19 (July, 1957).

The hyperfine interaction of the nucleus with the ion core spins in magnetic crystals provides a relaxation mechanism for the nuclear spins since energy conservation can be obtained by a change in the spin-wave energy. In nonconducting magnetic crystals this mechanism may be dominant in the relaxation of the nuclei of the magnetic ions. The relaxation time is calculated for such a nucleus in an antiferromagnetic crystal. A.

538.114

1124. A NOTE ON THE ISING MODEL WITH SECOND NEAREST NEIGHBOUR INTERACTIONS. E.W.Elcock.
Proc. Phys. Soc. A., Vol. 70, Pt 8, 615-16 (Aug., 1957).

538.221

1125. ELEMENTARY DOMAINS ON THE {100} FACES OF NICKEL FERRITE CRYSTALS AND ON THE (0001) FACE OF BARIUM FERRITE CRYSTALS. M.Paulus.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2227-30 (Dec. 16, 1957).
In French.

Powder patterns are shown for the two ferrites and the results discussed; striking maze patterns were observed for the barium ferrite. E.P.Wohlfarth

538.221 : 538.65

1126. MAGNETIC INFLUENCE ON THE RECRYSTALLIZED GRAIN TEXTURE OF A FERROMAGNETIC ALLOY.
B.Sawyer and R.Smoluchowski.
J. appl. Phys., Vol. 28, No. 9, 1069-70 (Sept., 1957).

Annealing an Fe + 35% Co alloy cold-rolled sheet in a magnetic field at 700°C increases the proportion of those grains having a ⟨100⟩ direction parallel to the field whilst decreasing those with a ⟨110⟩ direction similarly oriented. The result can not be explained by the crystalline anisotropy of the magnetic energy and the effects of thermal variables are believed to be more important. D.J.Oliver

538.221

1127. SINGLE CRYSTAL "PICTURE FRAMES" OF FERROMAGNETIC ALUMINUM–IRON ALLOYS. R.C.Hall.
J. appl. Phys., Vol. 28, No. 10, 1212 (Oct., 1957).

The order–disorder transformation for Fe–Al alloys (18% to 33% Al) was investigated magnetically. "Picture frames" were cut in the [100] directions and subjected to two types of heat treatment. Slow cooling in a magnetic field of 4 Oe had no effect. Rapid cooling of a 21.9% Al alloy caused the easy direction of magnetization to change from [111] to [100] direction. For alloys around 30% Al a similar treatment is thought to produce varying amounts of a magnetic phase (Fe_3Al) and a non-magnetic phase (FeAl).

D.J.Oliver

538.221 : 537.311.33

1128. MAGNETIC AND ELECTRICAL ANISOTROPIES OF THE IRON SULFIDE SINGLE CRYSTAL.
T.Hihara, M.Murakami and E.Hirahara.
J. Phys. Soc. Japan, Vol. 12, No. 6, 743 (June, 1957).

An extension of previous work (Abstr. 6638/1956, 5458/1957) to temperatures up to 400°C, covering the Néel point, 330°C. Discontinuities in the slope of the susceptibility and resistivity curves in the two principal directions are observed at this temperature, and these are interpreted in terms of the spin coupling.

E.P.Wohlfarth

538.221

1129. STUDY OF THE MAGNETIC LEAKAGE FIELD IN COBALT BY MEANS OF A DIVERGENT ELECTRON BEAM.
M.Blackman and E.Grünbaum.
Nature (London), Vol. 180, 1189-90 (Nov. 30, 1957).

A continuation of previous work (Abstr. 2432/1957). The divergent beam scans an extended region parallel to an edge of a cobalt crystal. Trochoidal curves are obtained close to the prism and hexagonal faces, and these change their character reversibly during temperature cycling to above the isotropy temperature where the leakage field is small. E.P.Wohlfarth

538.221

1130. DETERMINATION OF THE GYROMAGNETIC RATIO AND THE MAGNETIC RESONANCE DAMPING COEFFICIENT OF FERRITES. H.G.Beljers.
Philips Res. Rep., Vol. 13, No. 1, 10-16 (Feb., 1958).

Resonance experiments are described on polycrystalline ferrite spheres in a microwave cavity with a linearly polarized magnetic field. Fundamental quantities, like the g-factor and the damping coefficient of the ferrite, are derived from the measurements. The damping coefficient can be calculated either from a line-width measurement or from the maximum amount of absorption in the ferrite at resonance. Results obtained by these two methods were found to be in reasonable agreement. A.

538.222

1131. PARAMAGNETISM OF SOLUTIONS OF AROMATICS IN STRONG ACIDS. C.MacLean and J.H.van der Waals.
J. chem. Phys., Vol. 27, No. 3, 827 (Sept., 1957).

It is concluded, from the results of electron-spin resonance experiments on solutions of anthracene, pyrene and thianthrene in sulphuric acid and hydrofluoric acid, that the conjugate acid ions, formed by the interaction of a proton with the aromatics, have no biradical character. The paramagnetism shown by solutions in sulphuric acid is believed to be due to oxidation products of the aromatics. A.E.De Barr

538.222

1132. PARAMAGNETIC SUSCEPTIBILITY OF $CoCl_2.6H_2O$ BETWEEN 290°K–1.52°K. T.Haseda and E.Kanda.
J. Phys. Soc. Japan, Vol. 12, No. 9, 1051 (Sept., 1957).

Reports results of susceptibility measurements, which indicate a Néel point at 3°K, followed by Curie–Weiss behaviour at higher temperatures. E.P.Wohlfarth

538.245

1133. MAGNETIC ANNEALING EFFECT IN IRON–NICKEL FERRITES. Y.Aiyama, H.Sekizawa and S.Iida.
J. Phys. Soc. Japan, Vol. 12, No. 6, 742 (June, 1957).

The dependence of the uniaxial anisotropy of Fe–Ni ferrites on the concentration of cation vacancies has been studied. The cation/anion ratio was varied by varying the degree of oxidation of the specimens, and the results show that the magnitude of the uniaxial anisotropy increases with the degree of oxidation.

A.E.De Barr

538.245

1134. THE REMANENT MAGNETIZATION OF SINGLE DOMAIN FERROMAGNETIC PARTICLES. E.P.Wohlfarth and D.G.Tonge.
Phil. Mag. (Eighth Ser.), Vol. 2, 1333-44 (Nov., 1957).

The remanent magnetization is calculated for particles with a number of equivalent easy directions of magnetization, and also for particles with mixed uniaxial anisotropies. Application is made to a variety of materials. In an appendix the magnetization curves for particles with unidirectional anisotropy are calculated. A.

538.245 : 538.662

1135. SOME MAGNETOTHERMAL RELATIONS FOR FERROMAGNETICS. R.W.Teale and G.Rowlands.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1123-34 (Dec., 1957).

An expression is derived which relates associated magnetic and thermal changes for reversible rotation of the intrinsic magnetization or reversible domain wall motion. A coefficient in the expression depends upon the type of internal magnetic energy change which accompanies these processes, and hence experiments are proposed to differentiate between the various possible energy changes. An effect arising from the second term in the magnetocrystalline energy expressions is predicted. A.

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3 : 523.746

1136. RADIAL PULSATIONS OF A CYLINDRICAL MAGNETIC TUBE OF FORCE IN TEMPERATURE EQUILIBRIUM WITH A PLASMA. E.Jensen.
Astrophys. Norveg., Vol. 5, No. 12, 289-97 (March, 1957).

Within a cylindrical magnetic flux tube in temperature equilibrium with a surrounding plasma the density is less than outside. The equation governing radial pulsations of such a magnetic cavity is derived and solved in the case of a constant magnetic field within the cylinder and with boundary conditions corresponding to an incompressible medium in the surroundings. The amplitudes of the different modes are Bessel functions. The expression for the eigenvalues shows that the magnetic field reduces the periods below the values corresponding to an elastic vibration. It is suggested that oscillations appearing in sunspot magnetic fields may be of a similar nature. A.

538.3

1137. CHARGED PARTICLES IN A NON-UNIFORM RADIO-FREQUENCY FIELD. H.A.H.Boot and R.B.R.-Shersby-Harvie.
Nature (London), Vol. 180, 1187 (Nov. 30, 1957).

Spatial variation of electric-field strength gives rise to a second-order force; it is reported that, under certain conditions, particles of either sign will experience acceleration towards position of least field strength. The result is related to the problem of confining a heated plasma by radiation pressure. R.A.Newing

538.312 : 530.12

1138. THE ENERGY CURRENT VELOCITY IN THE ELECTROMAGNETIC FIELD. H.G.Schöpf.
Z. Phys., Vol. 148, No. 4, 417-24 (1957). In German.

It is shown that the velocity of energy propagation satisfies the relativistic law for the composition of velocities if the energy-momentum tensor is expressible in the form U_iV_k. This condition is satisfied by the Minkowski tensor for the pure radiation field, but it is possible to construct other tensors also satisfying this condition. R.A.Newing

ELECTROMAGNETIC WAVES AND OSCILLATORS

538.561

1139. PROPOSAL FOR A NUCLEAR QUADRUPOLE MASER. R.Braunstein.
Phys. Rev., Vol. 107, No. 4, 1195-6 (Aug. 15, 1957).

Proposal for an amplifier or an oscillator using a substance containing nuclei with $I \geq \frac{5}{2}$ or $I \geq 2$ in a non-cubic crystalline

electric field. The emission of radiation by the quadrupole transitions for which $\Delta|M| = 1$ is stimulated by the saturation of the transitions $\Delta|M| = 2$. The conditions underlying the choice of a suitable material are briefly outlined and it is suggested that I_2 or its compounds may be satisfactory. It might be possible to generate microwave frequencies using nuclei of atomic number > 50. See Abstr. 1181 (1957). D.J.Oliver

538.561 : 537.534 : 537.533

ELECTROMAGNETIC WAVES IN ELECTRON–ION BEAMS. See Abstr. 1088

538.566 : 621.371

1140. DIFFRACTION BY CYLINDRICAL REFLECTORS.
R.Plonsey.
Proc. Instn Elect. Engrs, Monogr. 281R, publ. Jan., 1958 (Vol. 105C, 312-17).

Republication of the monograph abstracted in Abstr. 663 (1958).

538.566.2

1141. SCATTERING OF ELECTROMAGNETIC WAVES BY AN ACOUSTIC DISTURBANCE IN THE ATMOSPHERE. A.Tonning.
Appl. sci. Res. B, Vol. 6, No. 6, 401-21 (1957).

The variations in density associated with an acoustic wave are shown to influence the propagation of an electromagnetic wave. The variation in dielectric permittivity of the atmosphere caused by an acoustic wave is expressed by the power density of the wave. Under the assumption that the acoustic waves are spherical, the scattered field at large distances is given in terms of definite integrals which are evaluated by means of the method of stationary phase. The limiting case of plane acoustic waves is discussed, and two numerical examples are given. A.

538.566.3 : 621.396.8

1142. DELAYED SIGNALS IN IONOSPHERIC FORWARD-SCATTER COMMUNICATION. G.W.Luscombe.
Nature (London), Vol. 180, 138 (July 20, 1957).

Evidence is presented that the longest-delay signals received on 37 Mc/s during E-region forward-scatter pulse experiments are due to round-the-world propagation, and are distinct from those of shorter delay which are attributed to ground back-scatter behind the transmitter following F2-reflections. G.M.Brown

NUCLEAR AND ATOMIC PHYSICS

APPARATUS. PARTICLE DETECTORS

539.1.07

1143. A QUENCHING PROBE UNIT FOR GEIGER–MÜLLER TUBES. F.W.Lovick.
J. sci. Instrum., Vol. 34, No. 9, 370-2 (Sept., 1957).

A modification of the A.E.R.E. Probe Unit Type 1014 (Abstr. 2561/1949). This unit replaces the cathode-follower drive to control and screen grids of the input stage of the basic flip-flop by a cathode-follower output. This allows transmission of the output pulse over long cables, at the expense of reduced stability and dead-time definition. The variation in dead-time due to differences in input pulse-height may be about 4-8%, at 500 μsec, depending upon the type of G.M. tube used. The dead-time is continuously variable over an unstated total range which includes 500-600 μsec, and the maximum sensitivity is about 0.3 V. The probe operates from the normal scaling-unit power supplies. T.H.D.Attewell

539.1.07

1144. ACOUSTIC IONIZATION DETECTOR.
D.R.Whitehouse and F.S.Replogle,Jr.
Trans Amer. Inst. Elect. Engrs I, Vol. 76, 406-9 (1957) = Commun. and Electronics, No. 32 (Sept., 1957).

A unique a.c. ionization chamber is described utilizing the acoustic pressure generated within an ionized gas by an applied a.c. field. On the basis of preliminary theory an experimental neutron-sensitive chamber was designed. The instrument has an approximate sensitivity of 1.5×10^7 neutrons per square centimeter per second and proves to be rugged and fast. A.

539.1.07

1145. A WF_6 BUBBLE CHAMBER.
E.D.Alyea, Jr, L.R.Gallagher, J.H.Mullins and J.M.Teem.
Nuovo Cimento, Vol. 6, No. 6, 1480-8 (Dec., 1957).

A small bubble-chamber was constructed for testing corrosive, high-density liquids. Its successful operation with tungsten hexafluoride (WF_6) is described, together with some of the techniques necessary for handling this liquid and measurements of its physical properties. Some work on stannic chloride ($SnCl_4$) and stannic bromide ($SnBr_4$) is also summarized. A.

539.1.07 : 778.34

1146. SHRINKAGE OF NUCLEAR RESEARCH EMULSIONS.
W.M.Gibson and J.G.McEwen.
Nuovo Cimento, Vol. 7, No. 1, 67-70 (Jan. 1, 1958).

A method is described for obtaining accurate values for the shrinkage factor of nuclear research emulsions, and for testing the uniformity of the shrinkage with depth. The results obtained from one plate show a shrinkage factor near the surface 6% greater than near the glass. The importance of avoiding such variations, when accurate depth measurements are required, is stressed. A.

539.1.07

1147. FLUCTUATIONS OF TRACK PARAMETERS IN NUCLEAR EMULSIONS. B.J.O'Brien.
Nuovo Cimento, Vol. 7, No. 2, 147-62 (Jan. 16, 1958).

The fluctuations in nuclear-emulsion track parameters were studied in a G5 emulsion of low minimum grain density by measurements of the blob density and integral gap length of long tracks of relativistic heavy nuclei. The intrinsic variations arising from the statistical nature of the process of track formation were found to be in good agreement with those predicted by the Blatt fluctuation theory. Subjective, emulsion and other variations were found in some cases to be comparable to the intrinsic variations. A method of estimating these fluctuation effects in any general experimental measurement is given. A.

539.1.07

1148. PHOTOMETRIC ANALYSIS OF THE TRACKS IN THE NUCLEAR EMULSIONS. II. MEASUREMENT OF PHOTOMETRIC WIDTH. P.G.Bizzeti and M.Della Corte.
Nuovo Cimento, Vol. 7, No. 2, 231-9 (Jan. 16, 1958).

For Pt I, see Abstr. 3889 (1957). A simple and speedy method for the measurement of the photometrical width of the tracks in nuclear emulsions is described. The independence of this parameter from depth is tested; corrections for dipping tracks are also calculated under reasonable assumptions and successfully compared with experimental results. A.

539.1.07

1149. MEASUREMENTS OF IONIZATION.
G.Alvial, A.Bonetti, C.Dilworth, M.Ladu, J.Morgan and G.Occhialini.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 2, 244-53 (1956).

"Pisa Conference on Elementary Particles", see Abstr. 250(1958). Describes a method of identification of short tracks. The profile of the track was recorded with a micrometer and its mean thickness used as a measure of the ionization. J.W.G.Wignall

539.1.07 : 539.16.08 : 621.317.39

1150. A MINIATURE UNIT FOR CONTROLLING THE DURATION OF RADIOACTIVITY MEASUREMENTS.
M.C.B.Russell and J.C.Boag.
Electronic Engng, Vol. 29, 532-5 (Nov., 1957).

The duration of the count is measured with a maximum error of 20 msec in units of time which are displayed on a register. A count is automatically terminated by preset count or time limits, but its duration is always made equal to a whole number of time periods. The circuit is designed for inclusion in a scaler of conventional design. A.

539.1.07

1151. A SIMPLE PULSE SPECTROGRAPH. N.R.Hansen.
J. sci. Instrum., Vol. 34, No. 10, 402-4 (Oct., 1957).

The usual saw-tooth time-base of an oscilloscope is replaced by one in which the spot moves with acceleration. Pulses from a radiation detector are displayed as bright dots which occur mainly on the side of the screen where the spot is moving slowly. Integration by time exposure with stationary film gives a record in which a constant-density line is a graph of pulse frequency against pulse height. Visual observation of the spectrum is possible with abundant pulses. The two simple circuits used employ only four tubes between them. A.

ELEMENTARY PARTICLES

539.12

1152. THE PRINCIPLE OF THE MINIMUM NUMBER OF STATES AT WEAK INTERACTIONS. G.Marx.
Nuovo Cimento, Vol. 6, No. 5, 1235-7 (Nov., 1957).

The hypothesis "The number of states of an elementary particle, when taking properly account of the invariance properties of its interactions, is minimum" yields automatically the two-component theory of the neutrino. Applications to other particles are also straightforward. P.Roman

539.12 : 530.145

1153. DETECTION OF PARTICLES INSIDE POTENTIAL BARRIERS. R.G.Winter.
Nature (London), Vol. 180, 1471 (Dec. 28, 1957).

It is shown that any attempt to localize a particle of energy E inside a barrier of potential energy $V_0 > E$, by its scattering of a photon beam, will result in a transfer of energy greater than $V_0 - E$ to the particle. M.J.Kearsley

539.12

1154. GENERAL THEORY OF PARTICLE MIXTURES. K.Aizu.
Nuovo Cimento, Vol. 6, No. 5, 1040-51 (Nov., 1957).

The general theory of particle mixtures is developed and their remarkable time behaviour at decay is shown to be a natural consequence of degeneracy of the initial state. Applications to several simple cases, positronium in a magnetic field, K^0 and $\overline{K}^0$ particle mixture and a possible θ-τ doublet are discussed. In particular it is shown that, if the K^0 has two lifetimes, the mass difference between K^0 and $\overline{K}^0$ caused by a possible non-invariance of strong interaction under charge-conjugation cannot much exceed the value 10^{-5} eV. A.

539.12

1155. THE THEORY OF ANGULAR CORRELATIONS WITH POLARIZATION. F.Mandl.
Proc. Phys. Soc., Vol. 71, Pt 2, 177-93 (Feb., 1958).

The theory of angular correlations is reformulated using the algebra of tensor operators. This has important advantages resulting in considerable simplifications: (1) It enables one to deal in a uniform manner with all polarization problems for both particles and photons, leading automatically to expansions in terms of the most natural functions for any particular problem; (2) The intensity is expanded directly in terms of spherical harmonics, rather than "squaring" the expanded amplitude; (3) The quite unnecessary explicit introduction of sums over magnetic quantum numbers of products of Wigner coefficients and their subsequent elimination by means of cumbersome algebra are avoided; (4) In this procedure, the reduced matrix elements of certain tensor operators (formed from the polarization tensors) are calculated once and can then be used in all problems, since any angular correlation can be expressed simply in terms of these reduced matrix elements. A.

539.12 : 539.21

1156. CROSS SECTION FOR DISPLACEMENT OF ATOMS BY HEAVY PARTICLE IRRADIATION. T.Morimoto.
J. Phys. Soc. Japan, Vol. 12, No. 4, 442 (April, 1957).

Previous calculation by the author, which was limited to heavy charged high-energy (velocity $\cong 6 \times 10^8$ cm/sec) particles, is extended to the low-energy region (velocity $\cong 5 \times 10^5$ cm/sec) provided particles are heavy. Example: α-particle irradiation of Cu. A.E.D.Heylen

539.12

1157. MULTIPLE SCATTERING MEASUREMENTS IN NUCLEAR EMULSIONS. S.Rosendorff and Y.Eisenberg.
Nuovo Cimento, Vol. 7, No. 1, 23-38 (Jan. 1, 1958).

The practical use of the multiple scattering function, $\cos \eta\varphi$, introduced by Lipkin et al. (Abstr. 2684/1956), was examined by comparing its theory with experiment. At the same time the mean absolute angle according to Molière's scattering theory was compared with experiment for the second and third difference and the respective dispersions were determined experimentally. (The theoretical dispersion diverges in Molière's theory). A good agreement between theory and experiment was obtained in the cosine case, both for the mean value and the dispersions, as well as in the mean absolute angle case with cut-off. Writing the relative error of $p\beta$ as $D_{2,3}/\sqrt{n}$ (for the second and third differences, respectively) gave in the cosine case: $D_2 = 0.976$ and $D_3 = 1.36$, and in the mean absolute angle case (with cut-off at $4\langle|\varphi|\rangle$): $D_2 = 0.97$ and $D_3 = 1.37$. It is shown that, provided one restricts oneself to a certain class of estimates of $p\beta$, the above dispersion values are close to the minimum possible dispersion of $p\beta$. Also, an explanation is suggested for the known experimental fact that the ratio of the "scattering constants" K_3/K_2 is higher by a few percent than the expected value $\sqrt{\frac{3}{2}}$. A.

539.12 : 537.534.75

THE STOPPING OF LOW-ENERGY ATOMIC PARTICLES.
See Abstr. 1103

539.12

1158. AN EXPRESSION FOR THE IMAGINARY PART OF THE AMPLITUDE FOR DELBRUCK SCATTERING.
P.Kessler and P.Eberhard.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1599-602 (Nov. 4, 1957).
In French.

The imaginary part of this amplitude may be significant in the scattering of 2.6 MeV γ-rays in Pb. Expressions for it are derived in Born approximation; evaluation is deferred. R.J.N.Phillips

539.12

1159. THE ELECTROMAGNETIC CASCADE WITH TRIDENTS.
J.W.Gardner.
Nuovo Cimento, Vol. 7, No. 1, 10-22 (Jan. 1, 1958).

Recent results claiming anomalously large cross-sections for direct pair-creation by high-energy electrons (mainly above 10 GeV) are discussed with particular reference to their significance in the development of the electron–photon cascade. A qualitative estimate, using an admittedly crude model, suggests that the effect of such large "trident" cross-sections could drastically change the pattern of development in the early stages of a really-high-energy cascade. The detailed analytical formulation of cascade theory is then modified in such a way that numerical values of the cross-section for trident production, when these are satisfactorily established, can be readily inserted in the formulae used for computing the moments of the number distribution function. A.

539.12

1160. POLARIZATION EFFECTS IN BREMSSTRAHLUNG.
G.Böbel.
Nuovo Cimento, Vol. 6, No. 6, 1241-51 (Dec., 1957).

In pursuance of a method devised by Lipps and Tolhoek, the differential cross-section of bremsstrahlung is written as a sum of eight terms, each correlating the different polarizations of the electron in the initial and final states and of the emitted photon. The formulae of Bethe and Heitler and of May, Gluckstern and others are obtained as particular cases and discussion is also carried out as to the emission of circularly polarized photons from electrons having longitudinal and transversal spin respectively. A.

539.12

1161. SCATTERING OF POLARIZED POSITRONS BY POLARIZED ELECTRONS. J.M.C.Scott.
Phil. Mag. (Eighth Ser.), Vol. 2, 1472-4 (Dec., 1957).

The cross-sections for the scattering of polarized positrons and electrons by polarized electrons are calculated. A.

539.12

1162. DETECTION OF ELECTRON POLARIZATION BY DOUBLE SCATTERING. A.de-Shalit, S.Kuperman, H.J.Lipkin and T.Rothem.
Phys. Rev., Vol. 107, No. 5, 1459-60 (Sept. 1, 1957).

Electrons from P^{32} were first scattered through 90° by a foil of Al to convert the polarization from longitudinal to transverse: this polarization was then detected by scattering in a foil of Au. A left-right asymmetry of (5.4 ± 0.4)% was found whose sign showed that the original electrons were polarized backwards. M.A.Grace

539.12

1163. COULOMB SCATTERING OF POLARIZED ELECTRONS.
F.Gürsey.
Phys. Rev., Vol. 107, No. 6, 1734-5 (Sept. 15, 1957).

The longitudinal depolarization, L, and asymmetry ratio, A, are calculated in terms of the Mott functions occurring in the scattering matrix. Approximate analytic expressions are also derived, and the results are applied to a double-scattering experiment of de-Shalit et al. (preceding abstract). It is suggested that discrepancy between theory and experiment may be due to plural scattering in each of the scatterers. N.M.King

539.12

1164. ELECTRON SCATTERING AND MODEL INDEPENDENCE.
D.G.Ravenhall and D.R.Yennie.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 857-62 (Dec., 1957).

A critical examination is made of the hypothesis of model

independence in high-energy electron scattering from nuclei. Results are presented which indicate that, contrary to this hypothesis, any differences in nuclear charge distributions result in differences in the electron angular distributions which become more and more pronounced as the energy is increased. The fallacies of the arguments leading to this hypothesis are noted, and comments are made on the scattering process. A.

539.12

1165. CHARACTERISTIC ENERGY LOSS OF ELECTRONS PASSING THROUGH METAL FOILS: MOMENTUM-EXCITON MODEL OF PLASMA OSCILLATIONS. R.A.Ferrell and J.J.Quinn.
Phys. Rev., Vol. 108, No. 3, 570-5 (Nov. 1, 1957).

Previous work is extended so as to obtain a unified theory of collective and individual electron effects in the excitation of a degenerate electron gas by fast incident electrons. The two characteristically collective features of the characteristic energy loss, the relatively large magnitude and the sharpness of the energy, are shown to follow from a straightforward quantum-mechanical treatment of one-electron excitations, provided only that the interactions of the electrons are taken into account. The interaction causes the excitation to be transferred from one excited configuration to another, resulting in an exciton in momentum space. This "momentum-exciton" is a discrete state which separates from the continuum of one-electron excitations and rises to higher energy, in accordance with Hund's rule. Correlation is taken into account by means of Feynman graphs in which the excitation makes a "jog" and travels backwards in time, as well as forwards. With this refinement the identification of the momentum-exciton with the Bohm–Pines plasma oscillation is completed. A.

539.12

1166. TRANSMISSION OF ELECTRONS THROUGH ALUMINIUM FOILS. B.N.C.Agu, T.Burdett and E.Matsukawa.
Proc. Phys. Soc., Vol. 71, Pt 2, 201-6 (Feb., 1958).

Measurements have been made of the transmission through aluminium foils of an electron beam of initially monochromatic energy in the range 0.25-0.75 MeV. The current of transmitted electrons was measured directly, with a collecting cup and a galvanometer, this procedure yielding transmission curves of different shape from those obtained using Geiger counters or ionization chambers. The extrapolated range–energy relationship under these conditions also departs considerably from the generally accepted curve. A.

539.12

1167. ON THE DEPENDENCE OF THE CHARACTERISTIC ENERGY LOSS ON TEMPERATURE AND SCATTERING ANGLE. G.Meyer.
Z. Phys., Vol. 148, No. 1, 61-71 (1957). In German.

This was investigated for Al and Ge by the retarding-field method. The experimental results agree well with predictions from the electron plasma theory for crystals. J.Hughes

539.12

1168. DETERMINATION OF AN ABSOLUTE PAIR PRODUCTION CROSS SECTION BY RELATIVE MEASUREMENTS.
V.Shkolnik and S.Standil.
Canad. J. Phys., Vol. 35, No. 9, 1156-8 (Sept., 1957).

By comparing the production of annihilation radiation from two types of sources the absolute pair-production cross-section in one of them is obtained. The first source is a target of lead irradiated by the X-rays from Zn^{65}. The positrons produced in the target are absorbed in a graphite sheath and the consequent annihilation radiation is detected by crystal-photomultiplier combinations arranged for coincidence counting. With the Zn^{65} source removed the lead target is replaced by a Na^{22} source emitting positrons which are absorbed in a Lucite covering. Again the annihilation radiation is detected and the relative measurements of radiation in the two cases enable the pair-production cross-section in lead at 1.12 MeV, to be calculated as 13.8 ± 1 millibarns. L.E.Mussell

539.12

1169. THE ELASTIC SCATTERING OF POSITRONS BY ATOMS AND MOLECULES. H.S.W.Massey and A.H.A.Moussa.
Proc. Phys. Soc., Vol. 71, Pt 1, 38-44 (Jan., 1958).

The information available concerning the cross-sections for elastic scattering of slow positrons by helium, neon, argon and hydrogen is analysed in terms of collision theory. Evidence is found that the polarization of the neutral atom or molecule by the incident positron is important in these collisions. A variational calculation of scattering by atomic hydrogen does not support this conclusion. Further methods of investigating the problem are suggested. A.

539.12 : 530.162 : 533.7

NEGATIVE ENERGIES AND TEMPERATURES OF DIRAC POSITRON. See Abstr. 913

539.12 : 539.17

ELASTIC CROSS-SECTION OF 2 MeV POSITRONS IN ARGON. See Abstr. 760

539.12 : 537.591.8

NUCLEON–NUCLEON INTERACTION WITH ENERGY HIGHER THAN 10^{14} eV. See Abstr. 1117

539.12

1170. ON THE CHARGE DISTRIBUTION OF THE NUCLEON. Y.Nogami.
Nuovo Cimento, Vol. 6, No. 4, 985 (Oct., 1957).

The mean square radii and anomalous magnetic moments of the neutron and the proton are discussed on the basis of lowest order perturbation theory using pseudoscalar coupling. An attempt is made to estimate higher-order effects by ascribing an anomalous magnetic moment (equal to that of a real nucleon) to the virtual nucleon in intermediate states. This leads to "somewhat better agreement" for the anomalous moments but makes the charge distribution worse; the agreement in either case is poor. The effect of strange particles is considered on a similar basis, and found to be negligible. It is concluded that the conventional theory of the pion–nucleon interaction cannot account for the electromagnetic structure of the nucleon. P.K.Kabir

539.12

1171. A DISPERSION RELATIONSHIP FOR NUCLEON–NUCLEON SCATTERING. F.M.Kuni.
Vestnik Leningrad. Univ., Ser. Fiz. Khim., 1957, No. 10, 21-36.
In Russian with summary in English.

A theoretical paper, part of which was reported earlier (Abstr. 5063/1956). Calculations are given for the most interesting use in charge-symmetrical meson theory with pseudo-scalar coupling. C.R.S.Manders

539.12 : 539.17

1172. HIGH-ENERGY PROTONS. A.E.Taylor.
Rep. Progr. Phys., Vol. 20, 86-129 (1957).

Recent experiments with high-energy protons above 100 MeV are reviewed. Considerable data have been obtained from the study of proton–proton scattering below 400 MeV, especially where polarized beams have been used. It is now possible to extract the available information from such experiments by making phase-shift analyses. The neutron–proton scattering experiments, although not so numerous, are reviewed where they are relevant to these analyses. The phase shifts have not yet been determined unambiguously but the analyses have indicated the general trend and make it possible to test various models of the nucleon–nucleon interaction. At energies above 400 MeV the character of the scattering changes and the production of mesons becomes noticeable. At the highest energies now available from the Bevatron at Berkeley antiprotons are produced. Many of the experimental results in proton–nuclear scattering have been explained in terms of nuclear transparency, optical and statistical models, but careful measurements of inelastic scattering have suggested that more detailed models are required. The polarization in elastic scattering can be explained by an optical model with the addition of a spin–orbit coupling similar to that used in the shell model. The theoretical variation of the polarization with scattering angle displays sharp features near the diffraction minima but the observation of these tends to be obliterated by finite experimental angular resolution and detection of inelastically scattered particles. A.

539.12

1173. MEASUREMENT OF BETA ASYMMETRY IN THE DECAY OF POLARIZED NEUTRONS. M.T.Burgy, R.J.Epstein, V.E.Krohn, T.B.Novey, S.Raboy, G.R.Ringo and V.L.Telegdi.
Phys. Rev., Vol. 107, No. 6, 1731-3 (Sept. 15, 1957).

A beam of thermal neutrons from a reactor was polarized (87 ± 7%) by reflection from a magnetized Co mirror. Neutron decays were identified by electron–proton coincidences and the decay electron intensity was found to be smaller in the direction parallel to the neutron spin than antiparallel to it. For an angular distribution of the form $1 - \alpha (V/C) \cos\theta$, α is found to be 0.37 ± 0.11. M.A.Grace

539.12

1174. EXPERIMENTAL LIMIT TO THE ELECTRIC DIPOLE MOMENT OF THE NEUTRON.
J.H.Smith, E.M.Purcell and N.F.Ramsey.
Phys. Rev., Vol. 108, No. 1, 120-2 (Oct. 1, 1957).

An experimental measurement of the electric dipole moment of the neutron by a neutron-beam magnetic resonance method is described. The result of the experiment is that the electric dipole moment of the neutron equals the charge of the electron multiplied by a distance $D = (-0.1 \pm 2.4) \times 10^{-20}$ cm. Consequently, if an electric dipole moment of the neutron exists and is associated with the spin angular momentum, its magnitude almost certainly corresponds to a value of D less than 5×10^{-20} cm. A.

539.12

1175. A MULTIPLATE CLOUD CHAMBER STUDY OF UNSTABLE PARTICLES. M.Annis, N.F.Harmon and R.D.Sard.
Nuovo Cimento, Vol. 6, No. 5, 1155-67 (Nov., 1957).

A multiplate cloud chamber was operated at mountain altitude under a penetrating shower selector. The distribution of scattering angles of penetrating secondaries is used to determine jointly the exponent γ of their differential momentum spectrum and the noise level, σ_1, of the chamber. γ is 2 to 2.5, and σ_1 is less than 0.8×10^{-2} radians, corresponding to a maximum detectable momentum (standard error) of more than 2 GeV/c. Several unusual decays in flight were found. In one, a charged V-decay gives rise to a photon, recognized by the electron shower it produces. The event is interpreted as $K_{\pi 2} \rightarrow \pi + \pi^0$, the π^0 decaying in its normal (2γ) mode). In another, a V^0-decay gives an interacting penetrating particle and a particle producing an electron shower in the first plate it strikes. The event is dynamically compatible with $\theta^0 \rightarrow \pi + \pi + 214$ MeV, but the charge exchange that must then be postulated is very improbable. A more likely interpretation is β-decay: $K^0_\beta \rightarrow \pi + e + ?^0$. From the observed energy release the neutral particle must be massless if K^0_β has the same mass as the other K-particles. Finally, a case is reported that appears to be a cascade decay of a neutral V into a charged one. The charged V decays into an interacting light particle, probably a π-meson. The most likely interpretation in terms of presently known particles is $V^0 \rightarrow \Sigma^\pm + \pi^\pm$; $\Sigma^\pm \rightarrow \pi^\pm + n$, with a mass of at least 1390 MeV ($Q_{\Sigma\pi} \geq 60$ MeV). A.

539.12 : 530.162

A GENERAL TREATMENT OF EXPANDING SYSTEMS APPLIED TO MULTIPLE MESON PROCESSES. See Abstr. 894

539.12 : 530.145

PARITY NONCONSERVATION AND UNIVERSAL FERMI INTERACTION IN MESON DECAY. See Abstr. 879

539.12

1176. MASS MEASUREMENTS ON FAST PARTICLES FROM STARS. P.H.Fowler and D.H.Perkins.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 2, 487-9 (1956).

"Pisa Conference on Elementary Particles", see Abstr. 250 (1958). Report on a systematic analysis of masses of fast particles from cosmic-ray showers. In an early stack, 12 particles were observed with estimated masses about 1500 m_e, but in a later one no such particles were found. J.W.G.Wignall

539.12

1177. REMARKS ON THE POSSIBLE EXISTENCE OF A NEUTRAL MUON. R.E.Marshak and E.C.G.Sudarshan.
Nuovo Cimento, Vol. 6, No. 6, 1335-8 (Dec., 1957).

The arguments for and against the existence of a neutral muon are discussed. The weak interactions in which a neutral muon might replace the neutrino are enumerated. It is concluded that the most favourable experimental circumstances for the detection of the neutral muon would obtain if one searches for the reaction $K^+ \rightarrow \mu^+ + \mu^0$. A.

539.12 : 530.145

1178. ON THE CONSERVATION OF LEPTON NUMBER.
B.Ferretti.
Nuovo Cimento, Vol. 6, No. 4, 999-1000 (Oct., 1957).

The theorem of Pauli, that conservation of leptonic charge is independent of other invariance properties of weak interactions, is extended to the μ-decay interaction, for processes in which no neutrino appears in the final state. G.H.Burkhardt

539.12

1179. ON THE MEAN LIFE OF μ^--MESONS IN ELEMENTS OF MEDIUM AND HIGH ATOMIC NUMBER.
A.Alberigi-Quaranta, F.Pieraccini and D.Broadbent.
Nuovo Cimento, Vol. 6, No. 5, 1084-101 (Nov., 1957).

The mean life of μ-mesons stopped in iron was investigated by means of a new apparatus. The experimental arrangement for the determination of the mean life of μ^- in elements of mean and high atomic number is described. The deflection of the trajectory of a cosmic-ray μ-meson passing through two magnetized iron blocks ($B = 1.5$ Wb.m^{-2}) indicates the sign of the incoming meson. The deflection is measured by an hodoscope of 90 Geiger counters. A fast syncroscope determines the interval of time between the arrival of the meson and its disappearance in the absorbers due either to capture by nuclei or to the normal process of decay. The error in the reading of the time interval is $\sim 10^{-8}$ sec. The mean life of the meson in the element constituting the absorber is directly calculated from the distribution of the delays. The value for the mean life of the μ^--meson in iron was found to be $\tau = (16 \pm 1) \times 10^{-8}$ sec. A.

539.12

1180. THE INTERACTION RATES OF STOPPED NEGATIVE MUONS IN IRON AND COPPER.
A.M.Hillas, W.B.Gilboy and R.M.Tennent.
Phil. Mag. (Eighth Ser.), Vol. 3, 109-18 (Feb., 1958).

An apparatus suitable for measuring the mean lifetimes of negatively charged cosmic-ray muons brought to rest in targets of $Z < 30$ is described. Measurements made on iron and copper yield mean lifetimes of $(204 \pm 14) \times 10^{-9}$ sec and $(157 \times 20) \times 10^{-9}$ sec respectively. A.

539.12 : 537.591.1

1181. THE EFFECT OF THE ANGULAR VARIATION OF INTENSITY ON SCATTERING DISTRIBUTIONS OF μ-MESONS UNDERGROUND AT A DEPTH OF 40 m W.E.
J.E.Cousins, W.F.Nash and A.J.Pointon.
Nuovo Cimento, Vol. 6, No. 5, 1113-21 (Nov., 1957).

The interpretation of experiments carried out underground to investigate the large angle scattering of μ-mesons depends on the assumed form of the underground spectrum and the geometrical bias introduced by the counter selection system. The form of the angular variation of intensity at 40 m w.e. has been obtained. The effect of introducing this into the calculation of the geometrical correction factors is discussed. It is shown that previous workers who assumed normal incidence of all particles have underestimated the expected number of large angle scatters. A.

539.12

1182. THE STUDY OF POLARIZATIONS OF SECONDARY MUONS IN K-MESON DECAY PROCESSES.
S.Furuichi, S.Sawada and M.Yonezawa.
Nuovo Cimento, Vol. 6, No. 6, 1416-29 (Dec., 1957).

To get the knowledge of weak interactions acting in the K-meson decay processes having muons in their decay products, the authors investigated the polarization of the emitted muons in these processes, taking the viewpoint that the weak Fermi interaction is participating for the decay processes and the neutrino associated is of two components. For the determination of the type of weak interaction in the case of the $K_{\mu 3}$-meson it is useful to analyse the longitudinal polarization of muons. Although the main interest is in the type determination of weak interactions, the spin of the K-meson is also examined and the analysis shows that the polarization of muons is in general not complete for spin-1 $K_{\mu 2}$-mesons in contrast with spin-0 $K_{\mu 2}$-mesons. A.

539.12

1183. ENERGY SPECTRUM OF PIONS AND POLARIZATION OF MUONS AND ELECTRONS IN THE $K_{\mu 3}$ AND K_{e3} DECAY.
S.W.McDowell.
Nuovo Cimento, Vol. 6, No. 6, 1445-60 (Dec., 1957).

Two aspects of the $K_{\mu 3}$ and K_{e3} decay are discussed: the energy density of final states and the longitudinal polarization of the muons and electrons. It is assumed that the fermion pair is produced through a Fermi interaction which can be of scalar, vector or tensor type. The two-component theory of the neutrino is used. The energy spectra and polarization depend in general on three complex parameters. However, if the theory is to be invariant under time reversal, the parameters must be real. With the values of the parameters determined from the energy spectrum one can predict the polarization. This provides a good check of the two-component theory. A.

539.12

1184. μ-MESON POLARIZATION IN A STRONG MAGNETIC FIELD. W.H.Barkas, P.C.Giles, H.H.Heckman, F.W.Inman and F.M.Smith.
Phys. Rev., Vol. 107, No. 3, 911-12 (Aug. 1, 1957).

By imposing a constant magnetic field of 14250 gauss, muons

polarized in the $\pi-\mu$ decay process and brought to rest in emulsion were decoupled from local depolarizing fields. Analysis of 3500 $\pi\mu$e events enables the value of the asymmetry parameter "a" to be given as -0.23 ± 0.05. R.H.W.Johnston

539.12

1185. CONSIDERATIONS ON DEPOLARIZATION OF POSITIVE MUONS IN GASES; EFFECT OF MOLECULAR IONS. V.W.Hughes.
Phys. Rev., Vol. 108, No. 4, 1106-7 (Nov. 15, 1957).

The possible importance of this effect is considered; a semi-quantitative estimation for the case of He–μ^+ formation suggests that a considerable depolarization may result. G.H.Burkhardt

539.12

1186. SEARCH FOR THE ELECTRONIC DECAY OF THE POSITIVE PION. H.L.Anderson and C.M.G.Lattes.
Nuovo Cimento, Vol. 6, No. 6, 1356-81 (Dec., 1957).

A double-focusing magnetic spectrometer of high transmission (1.8%) and good resolution (3.0%) was used in a search for the electronic decay of the positive pion. No evidence was found. The fraction of decays of the type $\pi \rightarrow e + \nu$ was found to be $f = (-0.4 \pm 9.0) \times 10^{-8}$. The result appears to be statistically significant and thereby allows only a 1% probability that f could have a value greater than 2.1×10^{-5}. From a search for electrons of momentum 60.3 MeV/c it could be concluded that the fraction of decays of the type $\pi \rightarrow e + \gamma + \nu$ was $f_\gamma = (-2.0 \pm 1.6) \times 10^{-4}$ assuming tensor interaction determines the spectrum. Much lower limits for this last process have been reported by Cassels and by Lokanathan. A.

539.12

1187. PRODUCTION OF STRANGE PARTICLES BY 4.3 GeV π^- IN EMULSION. C.Besson, J.Crussard, V.Fouché, J.Hennessy, G.Kayas, V.R.Parikh and G.Trilling.
Nuovo Cimento, Vol. 6, No. 5, 1168-88 (Nov., 1957).

A large stack of emulsion was exposed in the 4.3 GeV π^- beam of the Berkeley Bevatron. 317 K^+ and 96 K^- stopping in the stack were observed; 184 K^+ and 66 K^- were followed back to an originating star made by a beam π^-. The origins of K^+ are larger than those of K^-, as far as the numbers of black and grey prongs are concerned, and the emission of the K^- is more concentrated in the forward direction than that of the K^+. Charged Σ of moderate energy were observed in the origin of K^+; their frequency is $0.17^{+0.12}_{-0.06}$ per star. The mean free paths for production of K^+ and K^- of energy < 150 MeV in emulsion are (4700 ± 1200) cm and (24 000 ± 7000) cm respectively. The majority of the K^+ stopping in the stack are probably produced in secondary collisions in the nucleus of pions resulting from the first impact of the incoming π^-. A larger fraction of the K^- is probably produced in the first collision. Approximate values of the production cross-sections of strange particles by the collisions of 4.3 GeV π^- with nucleons can be deduced from the study of suitably selected small origins of K^+ and K^-. The cross-section for the production of K^+ is ~ 0.7 mb. For K^-, it is probably ≥ 0.3 mb. It thus appears that as the pion energy increases from 1 to 4 GeV, there is no pronounced increase in the total cross-section for strange strange-particle production. The $K\bar{K}$ production becomes a substantial fraction of the total, and the direct hyperon production probably remains about constant or decreases. A.

539.12 : 530.145

1188. ANALYSIS OF PROCESSES INVOLVING BARYONS, PIONS AND HEAVY MESONS. D.Amati and B.Vitale.
Nuovo Cimento, Vol. 6, No. 6, 1282-91 (Dec., 1957).

The role played by the fields present in any strong interaction is analysed by means of dispersion relation techniques. This helps to clarify the effects of virtual states in physical processes where only a few of the many interacting fields are present in the initial and final states as real particles, and the way the renormalized coupling constants appear in the integral relations for the amplitudes corresponding to scattering, production and absorption processes. A.

539.12

1189. NEGATIVE PION SCATTERING AND THE DISPERSION RELATIONS. M.H.Zaidi and E.L.Lomon.
Phys. Rev., Vol. 108, No. 5, 1352 (Dec. 1, 1957).

It is shown that the integrals appearing in the forward-scattering dispersion relations for negative pion scattering on protons are quite sensitive to the chosen energy dependence of the total cross-section. It is further shown that a curve can be drawn through the experimental data which gives a much better fit to the forward scattering amplitude than that of Anderson, Davidon and Kruse, used by Puppi and Stanghellini (Abstr. 8408/1957), and with a value of the coupling constant consistent with positive pion scattering and with photoproduction. [The procedure used for obtaining the new curve is not given but, as the authors point out, the question should be settled by improved experimental accuracy in the 100 MeV region]. P.K.Kabir

539.12

1190. THEORY OF PHOTOPRODUCTION OF PIONS FROM NUCLEONS. J.Enoch, R.G.Sachs and K.C.Wali.
Phys. Rev., Vol. 108, No. 2, 433-45 (Oct. 15, 1957).

A resonance theory of the pion–nucleon system based on a very general static model is extended to give an expression for the pion photoproduction amplitude. It is found that for photon energies less than 500 MeV there are just two important terms in the amplitude, one of them describing direct photoejection of the pion and the other, photoexcitation of the $J = \frac{3}{2}$, $I = \frac{3}{2}$ resonance state of the nucleon. The first term is estimated by means of a weak-coupling, finite-source theory which is made gauge-invariant by introducing line currents in the source. Comparison with the threshold π^+ production leads to a coupling constant (without recoil correction) $f^2 = 0.049$. The behaviour of the cross-section at high energies does not appear to be consistent with this result. Much better agreement with the data above threshold is obtained for the uncorrected coupling constant $f^2 = 0.07$. However, serious discrepancies within the data make it impossible to resolve this difficulty at present. The behaviour of the photoejection part of the π^+ cross-section above the resonance is found to be sensitive to the form of the source function. With $f^2 = 0.049$ and a Gaussian source function, infinite cutoff comes closest to fitting the data. However a considerably better fit is obtained with $f^2 = 0.07$ and a cutoff of about 4 pion masses. The resonance term is sensitive to the form of the pion–nucleon phase-shift α_{33} above the resonance. The simple one-level form for the energy dependence of α_{33} (Chew–Low curve) is not found adequate to account for the data for high-energy photoproduction of pions; it is necessary to take account of the residue of higher resonances. Good agreement with the resonance term is obtained in terms of just two constant parameters, $\mathcal{M}$, the strength of the resonance matrix element, and Q, the contribution of higher resonances to the phase shift. No supporting evidence is found for a previously suggested S-wave, $I = \frac{1}{2}$ resonance. A.

539.12

1191. PHOTOPRODUCTION OF PION PAIRS IN HYDROGEN. M.Bloch and M.Sands.
Phys. Rev., Vol. 108, No. 4, 1101-2 (Nov. 15, 1957).

Negative pions produced in a hydrogen target by gamma-rays were detected using a magnet and scintillation-counter-telescope. Results are given for 50, 100 and 150 MeV π^-mesons at 60^0 and 120^0 laboratory angle. A preliminary analysis suggests a cross-section of 5×10^{-30} cm^2/sterad, not very dependent on the angle or photon energy in the energy region 600-1100 MeV. S.J.Goldsack

539.12

1192. A p, γ COINCIDENCE METHOD FOR THE MEASUREMENT OF π^0 PHOTOPRODUCTION. W.John and G.Stoppini.
Nuovo Cimento, Vol. 6, No. 5, 1206-10 (Nov., 1957).

A method has been developed to measure differential cross-sections for photoproduction of neutral pions from hydrogen below 260 MeV incident photon energies. The recoil protons are detected in coincidence with one of the decay γ-rays of the pion. The proton counter telescope utilizes a proportional gas counter as transmission counter. A lead-glass Cherenkov counter detects the γ-rays. A thin liquid hydrogen target with Mylar walls is used. Some cross-sections measured at 90^0 in the centre of mass are presented. A.

539.12 : 539.1.07

1193. THE θ^0 MESON.
R.W.Thompson, J.R.Burwell and R.W.Huggett.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 2, 286-318 (1956).

"Pisa Conference on Elementary Particles", see Abstr. 250 (1958). Report on an experimental study of the θ^0 decay, including a detailed description of the magnet and cloud chamber used, together with methods for dynamical analysis of the observations. A Q value of (214 ± 5) MeV is obtained. J.W.G.Wignall

539.12

1194. POLARIZATION OF μ^+ MESONS FROM THE DECAY OF K^+ MESONS.
C.A.Coombes, B.Cork, W.Galbraith, G.R.Lambertson and W.A.Wenzel.
Phys. Rev., Vol. 108, No. 5, 1348-51 (Dec. 1, 1957).

The forward–backward asymmetry coefficient, a, for the

angular distribution of positrons from the $K_{\mu 3}^{+} \rightarrow \mu^{+} \rightarrow e^{+}$ decay chain was measured. The result is $a = -0.31 \pm 0.04$, close to the value for the $\pi^{+} \rightarrow \mu^{+} \rightarrow e^{+}$ chain, and consistent with the Yang–Lee two-component neutrino theory. J.C.Taylor

539.12

1195. DISPERSION RELATIONS FOR HEAVY MESON–NUCLEON INTERACTION IN A FIXED SOURCE THEORY. I.
D.Amati and B.Vitale.
Nuovo Cimento, Vol. 6, No. 5, 1013-26 (Nov., 1957).

Dispersion relations for K–N and $\bar{K}$–N interactions are obtained in a fixed source approximation. The simultaneous presence of K and $\bar{K}$ in the heavy meson field is taken into account, as well as the interaction of the pion field with the barions. The dispersion relations for the forward scattering amplitudes are obtained without specifying the Hamiltonian in detail. The results are applied to the special cases of "scalar" and "pseudo-scalar" heavy mesons. For these special cases, a simpler method similar to that of Chew and Low is developed. Results are analysed and compared formally to those obtained in previous work where rather stringent approximations were done. The neglect of $\bar{K}$ in K–N scattering (and the inverse) seems unjustifiable. The presence of the pion field is effective in the definition of the K–N–Λ and K–N–Σ renormalized coupling constants, and gives rise to unphysical regions in the dispersion integrals. A.

539.12

1196. DISPERSION RELATIONS FOR HEAVY MESON–NUCLEON INTERACTION IN A FIXED SOURCE THEORY. II. EFFECTIVE RANGE RELATIONS. D.Amati and B.Vitale.
Nuovo Cimento, Vol. 6, No. 6, 1273-81 (Dec., 1957).

The dispersion relations derived in Pt I (preceding abstract), are used in order to obtain effective range type relations. Both scalar and pseudo-scalar K-mesons are considered. In the first section the desired inversion of the scattering amplitudes satisfying dispersion relations are carried out. The obtained effective range relations are discussed together with the possibility of obtaining approximate solutions for the scattering amplitudes starting directly from the dispersion relations. A.

539.12

1197. NUCLEAR COLLISIONS OF NEGATIVE K-MESONS.
W.Alles, N.N.Biswas, M.Ceccarelli and J.Crussard.
Nuovo Cimento, Vol. 6, No. 3, 571-84 (Sept., 1957).

A study of the interactions of K^{-}-mesons of 5-90 MeV in nuclear emulsions is described. The free proton elastic scattering has a cross-section of about 50 mb, and is substantially isotropic in the C-system. A rather small capture cross-section (~ 15 mb) is in sharp disagreement with a recent bubble-chamber measurement (Abstr. 8881/1957), but this could be due in part to a rapid variation of cross-section with energy. The interactions with heavy nuclei show a striking infrequency of K^{-} inelastic scatters, though K^{-}- p scattering is frequent. It is suggested that this difference could be due to an attractive K^{-}-nucleus potential, and a Monte Carlo calculation has been performed to test this theory. A brief discussion of other possible explanations is also given.

S.J.Goldsack

539.12

1198. CROSS SECTIONS FOR K^{-}–p INTERACTIONS.
R.G.Glasser, N.Seeman and G.A.Snow.
Nuovo Cimento, Vol. 7, No. 2, 142-6 (Jan. 16, 1958).

Nine $K^{-} + p$ elastic scattering events and eight $K^{-} + p \rightarrow \Sigma^{\pm} + \pi^{\pm}$ events were observed in nuclear emulsion. These events yield $\sigma(K^{-} + p \rightarrow K^{-} + p) = 33^{+13}_{-9}$ mb and $\sigma(K^{-} + p \rightarrow \Sigma^{\pm} + \pi^{\pm}) = 29^{+12}_{-9}$ mb averaged over the energy region 0-82 MeV. The data indicate that $\sigma(K^{-} + p \rightarrow \Sigma^{\pm} + \pi^{\pm})$ rises as the K^{-} energy decreases. A.

539.12

1199. INTERACTIONS AND DECAYS OF K^{-}-MESONS.
E.Lohrmann, M.Nikolić, M.Schneeberger, P.Waloschek and H.Winzeler.
Nuovo Cimento, Vol. 7, No. 2, 163-70 (Jan. 16, 1958).

Results on interactions in flight, elastic scatterings and decays of K^{-} mesons in nuclear emulsion in the energy interval between 5 and 130 MeV are given. A total K^{-}-path of 112 m was followed. 11 K^{-}–proton elastic scatterings and 5 K^{-}–(free) proton absorptions were found. The differential cross-section for elastic scatterings by complex nuclei for the two average energies of 45 and 100 MeV are listed. The mean free path for star production in the energy interval from 20 to 130 MeV is (27.7 ± 1.4) cm. The secondary tracks of the stars were, as far as possible, identified. 3 K^{-} re-emissions were observed. Finally the K^{-}-lifetime and some identified decays are discussed. From one of the two τ^{-}-mesons observed a mass value of (966.0 ± 1.8) m_e was obtained. One possible example of the $K_{\pi 2}$-decay mode was found. A.

539.12

1200. NUCLEAR INTERACTION OF 140 TO 218 MeV K^{+} MESONS.
B.S.Zorn and G.T.Zorn.
Phys. Rev., Vol. 108, No. 4, 1098-9 (Nov. 15, 1957).

The technique of scanning along the track in nuclear emulsions was applied to 122 metres of K^{+} track. The experimental results are given and are analysed using an optical model to obtain the K^{+}-meson nucleon cross-section from 60-218 MeV. S.J.Goldsack

539.12

1201. DISPERSION RELATIONS FOR MOMENTUM TRANSFER HEAVY MESON–NUCLEON SCATTERING. D.Amati and B.Vitale.
Nuovo Cimento, Vol. 7, No. 2, 190-9 (Jan. 16, 1958).

Relativistic dispersion relations for heavy meson–nucleon scattering are obtained for all momentum transfer. All the strong interacting fields are taken into account; results are given for both values of the relative parity of heavy mesons and hyperons. The comparison of the results with the forward dispersion relations obtained in a preceding paper (Abstr. 1195/1958) with a fixed source theory shows that the recoil contributions do not alter appreciably the dispersion relations. A.

539.12 : 539.14

1202. ABSORPTION OF NEGATIVE K-MESONS AND THE NEUTRON AND PROTON DISTRIBUTIONS IN HEAVY NUCLEI.
P.B.Jones.
Phil. Mag. (Eighth Ser.), Vol. 3, 33-41 (Jan., 1958).

Negative K-mesons captured by the heavy nuclei in nuclear emission form K-mesic atoms. It is shown that absorption occurs in the nuclear surface and takes place when the K^{-}-meson is in a 5g state. Observations on capture events producing a visible Σ^{-}-hyperon, and on the ratio of π^{+} to π^{-}-mesons created can give information on the relative neutron and proton densities in the part of the nuclear surface where the total density is less than 10% of the density at the centre of the nucleus. Experimental evidence suggests that in this region of the nucleus the density of neutrons is approximately equal to the density of protons. A.

539.12

1203. K-MESON PHOTOPRODUCTION IN A MANY FIELD INTERACTION. D.Amati and B.Vitale.
Nuovo Cimento, Vol. 6, No. 6, 1318-23 (Dec., 1957).

K-meson photoproduction is analysed by means of dispersion relation techniques, in order to clarify the role played by pion and $\bar{K}$ virtual states, the "crossing" relation between K photoproduction on nucleons and radiative absorption of $\bar{K}$ by nucleons, and the way charge and magnetic moments appear in the relation satisfied by the amplitude corresponding to the photoproduction process. A.

539.12

1204. SOME FURTHER MEASUREMENTS ON THE NEW HYPERON. Y.Eisenberg.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 2, 484-6 (1956).

"Pisa Conference on Elementary Particles" see Abstr. 250 (1958). Describes a confirmatory photometric measurement of the mass of the "primary hyperon" reported earlier by the author (Abstr. 1225/1955). An alternative interpretation of the event as a hyperon interaction in flight is discussed and considered unlikely. One of the tracks of the parent star from which the "heavy hyperon" is emitted appears to be due to a K-meson. J.W.G.Wignall

539.12

1205. ON THE Q-VALUES OF THE Λ^{0} AND THE θ^{0} AND ON THE ANOMALOUS V^{0}-DECAYS. C.D'Andlau, R.Armenteros, A.Astier, H.C.DeStaebler, B.P.Gregory, L.Leprince-Ringuet, F.Muller, C.Peyrou and J.H.Tinlot.
Nuovo Cimento, Vol. 6, No. 5, 1135-54 (Nov., 1957).

A study of 161 V^{0}-decays observed in the momentum chamber at the Pic du Midi has been made. These events correspond to a strict choice based on the measurability of the momenta of both secondaries (better than 10%). The main results are: (1) No direct evidence for anomalous neutral hyperon decays. Upper limits (6 to 8%) can be placed on the existence of various hypothetical modes. (2) The Q-values for the Λ^{0}-decay: $Q_{\Lambda^{0}} = (37.9 \pm 0.4)$ MeV. (3) The direct identification of the π nature of both secondaries of the θ^{0} decay-mode. (4) The Q-value for θ^{0}-decay: $Q_{\theta^{0}} = (217 \pm 4)$ MeV. (5) A direct proof of the non identity of the particles responsible for the θ^{0}-decay and the anomalous V^{0}-decays based on the significant difference between the number of slow and fast events of each category. A.

539.12

1206. PARITY NON CONSERVATION AND THE $\Delta I = \frac{1}{2}$ RULE IN HYPERON DECAYS. C.Ceolin.
Nuovo Cimento, Vol. 6, No. 4, 1006-7 (Oct., 1957).

The branching ratio of the Σ^{+}-meson decay modes and the ratio

of negative to positive Σ-meson lifetimes are calculated under the hypothesis that $\Delta I = \frac{1}{2}$ in the decay process, with an arbitrary amount η of parity nonconservation. It is claimed that the experimental values of these ratios require a value of $\eta^2 = 0.3$ although this "depends very critically on the experimental data and, as these are affected by an error of about 15%, the value of η^2 may vary considerably". P.K.Kabir

539.12

1207. DETECTION OF PARITY NONCONSERVATION IN Λ DECAY. F.S.Crawford, Jr, M.Cresti, M.L.Good, K.Gottstein, E.M.Lyman, F.T.Solmitz, M.L.Stevenson and H.K.Ticho.
Phys. Rev., Vol. 108, No. 4, 1102-3 (Nov. 15, 1957).

The decay of hyperons was studied in a 10 in. hydrogen bubble-chamber, by measuring the correlation of the decay direction and the plane of production. Large violation of parity conservation is found for 353 Λ^0-decays. The asymmetry parameter $\alpha \bar{P} = 0.44 \pm 0.11$, compared with a maximum value of 0.18 ± 0.02 if invariance under charge conjugation were preserved. There was no statistically significant evidence of parity violation in 122 Σ^-- decays. G.H.Burkhardt

539.12

1208. DEMONSTRATION OF PARITY NONCONSERVATION IN HYPERON DECAY. F.Eisler, R.Plano, A.Prodell, N.Samios, M.Schwartz, J.Steinberger, P.Bassi, V.Borelli, G.Puppi, G.Tanaka, P.Woloschek, V.Zoboli, M.Conversi, P.Franzini, I.Mannelli, R.Santangelo, V.Silvestrini, D.A.Glaser, C.Graves and M.L.Perl.
Phys. Rev., Vol. 108, No. 5, 1353-5 (Dec. 1, 1957).

263 events of associated production and decay of Λ particles in bubble chambers were measured to find the up-down asymmetry coefficient, a, of the final π^- relative to the production plane. It was found $a = 0.40 \pm 0.11$, giving strong evidence of parity violation in the decay. From the backward—forward asymmetry of the production, an upper bound is placed upon the Λ polarization. From this it is concluded that the asymmetry coefficient, α, for the decay of completely polarized Λ particles must satisfy $|\alpha| \geq 0.77 \pm 0.15$. For Σ particles, no statistically significant asymmetry was observed. J.C.Taylor

539.12

1209. TEST OF CHARGE-CONJUGATION INVARIANCE IN HYPERON DECAY. R.Gatto.
Phys. Rev., Vol. 108, No. 4, 1103-4 (Nov. 15, 1957).

If the Λ decay interaction were invariant under charge-conjugation, it would follow that the up-down asymmetry coefficient, α, for the decay $\Lambda \rightarrow p + \pi^-$ must satisfy $|\alpha| \leq 0.18 \pm 0.02$. The observed value of α definitely does not satisfy this inequality. J.C.Taylor

539.12 : 537.591.15

1210. LIFE TIME ESTIMATE OF Λ^0 AND θ^0 PARTICLES. C.Ballario, R.Bizzarri, B.Brunelli, A.De Marco, E.Di Capua, A.Michelini, G.C.Moneti, E.Zavattini and A.Zichichi.
Nuovo Cimento, Vol. 6, No. 4, 994-6 (Oct., 1957).

Neutral V-particles created in penetrating showers occurring in an iron block were detected in a multiplate cloud-chamber. The distributions in the chamber of 25 Λ^0 particles and 38 θ^0 particles for which identification was certain gave lifetimes $2.14 \pm^{0.80}_{0.47} \times 10^{-10}$ sec and $0.92 \pm^{0.30}_{0.18} \times 10^{-10}$ sec respectively. S.J.Goldsack

539.12

1211. THE BINDING ENERGY OF SIGMA HYPERONS WITH NUCLEONS. F.Ferrari and L.Fonda.
Nuovo Cimento, Vol. 6, No. 5, 1027-33 (Nov., 1957).

The binding of Σ hyperons with single nucleons is discussed assuming that the interaction takes place either through pions, or K-mesons or both. It appears that in order to obtain a bound system, the most reasonable assumption is to consider both the pion- and the K-forces. A.

539.12

1212. EXPERIMENTAL DETERMINATIONS OF THE Λ^0 AND Σ^- SPINS. F.Eisler, R.Plano, A.Prodell, N.Samios, M.Schwartz, J.Steinberger, P.Bassi, V.Borelli, G.Puppi, H.Tanaka, P.Woloschek, V.Zoboli, M.Conversi, P.Franzini, I.Manelli, R.Santangelo, V.Silvestrini, G.L.Brown, D.A.Glaser and C.Graves.
Nuovo Cimento, Vol. 7, No. 2, 222-30 (Jan. 16, 1958).

The applicability of the argument of Adair (Abstr. 4007/1957) to the determination of the hyperon spins is discussed on the basis of the observed distribution in the production angle for the process $\pi + N \rightarrow Y + \theta$. Because of the pronounced backward and forward peaking of these distributions it is found possible to use a large fraction of the events without jeopardizing the validity of the argument. From measurement of the distribution in the correlation angles between incident and outgoing pions it was found that the spins of both the Λ^0 and Σ hyperons are one half. The only assumptions necessary to this result are (1) that the θ spin is zero and (2) that the interaction radius for strange particle production is not pathologically large. A.

539.12

1213. CHARGE INDEPENDENCE AND HYPERON PRODUCTION. J.L.Brown, D.A.Glaser, D.I.Meyer, M.L.Perl, J.V.Velde and J.W.Cronin.
Phys. Rev., Vol. 107, No. 3, 906-8 (Aug. 1, 1957).

Cross-sections for hyperon production in hydrogen were measured using a propane bubble-chamber exposed to the 1.1 BeV pion beams of the Brookhaven cosmotron. The angular distributions obtained indicate that Σ-hyperon production is not charge independent. Possible instrumental biasses are considered, in particular the difficulty of identifying the Σ^0 production process. R.H.W.Johnston

539.12

1214. POSSIBLE VIOLATION OF CHARGE INDEPENDENCE IN STRONG INTERACTIONS. J.J.Sakurai.
Phys. Rev., Vol. 107, No. 3, 908-9 (Aug. 1, 1957).

Experimental differential cross-sections for the processes

$$\pi^- + p \rightarrow \Sigma^- + K^+$$
$$\rightarrow \Sigma^0 + K^0$$
$$\rightarrow \Lambda^0 + K^0$$

impose severe restrictions on the cross-section for the process $\pi^+ + p \rightarrow \Sigma^+ + K^+$ if charge independence holds. Recent measurements (preceding abstract) show that these restrictions are violated. It is pointed out that if I-spin is not conserved in strange particle interactions, it is necessary to reformulate the strangeness rules without reference to it. R.H.W.Johnston

539.12

1215. THE RANGE—DEPTH RELATION IN THE DEUTERON PROBLEM. P.Pluvinage and J.Proriol.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2201-3 (Dec. 16, 1957).
In French.

The variational approach to the deuteron problem of Hulthen and Laurikainen is extended to cover the case of a hard core potential, by expanding the wave-function in terms of Jacobi polynomials. S.F.Edwards

539.12

1216. EFFECT OF THE SPIN—ORBIT POTENTIAL ON THE MAGNETIC MOMENT OF THE DEUTERON. J.J.Swart, R.E.Marshak and P.S.Signell.
Nuovo Cimento, Vol. 6, No. 5, 1189-92 (Nov., 1957).

It is shown that at the present stage the contribution to the magnetic moment of the deuteron does not pose a serious dilemma for the spin—orbit potential explanation (in addition to the Gartenhaus potential) of the high-energy nucleon—nucleon scattering (up to 150 MeV). A.

NUCLEUS

539.14 : 539.18

1217. NUCLEAR FORCES AND THE STRUCTURE OF THE LITHIUM ISOTOPES. J.M.Soper.
Phil. Mag. (Eighth Ser.), Vol. 2, 1219-25 (Oct., 1957).

By consideration of the observed spectrum of Li^6 in intermediate coupling, values are obtained for the p-shell radial integrals, the spin—orbit force parameter and two of the three independent parameters of the exchange character of the central force. These results are used to calculate the spectrum and properties of Li^7 in intermediate coupling. Fresh evidence is found for the assignment of the 7.46 MeV level in Li^7 to the $5/2^-$ level of the ^{24}P term, indicating the probable presence of a further $5/2^-$ level (from the ^{22}F term) in the 5 to 7 MeV region. A.

539.14

1218. ON THE INTRODUCTION OF COLLECTIVE VARIABLES FOR DESCRIBING NUCLEI. M.Jean and J.Touchard.
C.R. Acad.Sci. (Paris), Vol. 245, No. 12, 1001-3 (Sept. 16, 1957).
In French.

A way of introducing collective variables, with the help of redundant coordinates, is discussed. R.J.N.Phillips

539.14

1219. ON THE FOUNDATIONS OF THE BRUECKNER THEORY OF THE NUCLEUS. H.Kümmel.
Z. Naturforsch., Vol. 12a, No. 1, 85-7 (Jan., 1957). In German.

Starting from exact equations, the Brueckner theory is reached through a series of approximations. R.J.N.Phillips

539.14

1220. THE BINDING ENERGY OF ^{8}Be AND ^{12}C. S.J.Biel.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 866-76 (Dec., 1957).

A general group-theoretic method is given for the enumeration of the integrals in the resonating group structure method of the alpha-particle model of the alpha nuclei. The general methods are then applied to the calculation of the binding energies of Be^{8} and C^{12}. These calculations are carried out using Gaussian wave-functions and a Gaussian central force potential, which is taken to be the mixture of the Wigner, Bartlett, Heisenberg and Majorana interactions. The variational method is used to fix the parameter determining the separation between the alpha-particle clusters. Two types of exchange dependence of the potential are considered corresponding to symmetrical forces and to Serber forces respectively. The former gives no binding (both for Be^{8} and C^{12}) while the latter overestimates the binding energies. A mixture of about 30% of the symmetric force and 70% of the Serber force gives the correct values for the binding energies. A simple transformation is used to calculate the Coulomb energy from the previously evaluated integrals for the Gaussian potential. A.

539.14

1221. AUDIO-FREQUENCY NUCLEAR-RESONANCE ECHOES. J.G.Powles and D.Cutler.
Nature (London), Vol. 180, 1344-5 (Dec. 14, 1957).

Nuclear spins are initially polarized in a large field and then allowed to precess freely in the earth's field. At a time τ later a "180° pulse" is applied at the resonance frequency and after a further time τ an echo appears. Both T_2 and T_1 can be obtained by suitable arrangements of pulses. The apparatus is simple and inexpensive and, although samples of ~ 100 ml are at the moment required to give adequate signals, some improvements can be expected. D.J.Oliver

539.14 : 539.17

1222. AN INVESTIGATION OF THE REACTIONS ^{24}Mg(d,p)^{25}Mg AND ^{26}Mg(d,p)^{27}Mg BY MAGNETIC ANALYSIS. S.Hinds, R.Middleton and G.Parry.
Proc. Phys. Soc., Vol. 71, Pt 1, 49-60 (Jan., 1958).

Angular distributions have been measured of some proton groups emitted from targets of natural magnesium and MgO^{26} when bombarded by 8.9 MeV deuterons. These distributions have been fitted with curves calculated from the deuteron stripping theories enabling assignments of parities and possible spins to be made to the states of the residual nuclei. The reduced level widths of these states have been calculated in absolute units. Several proton groups were observed corresponding to previously unreported levels in Mg^{25} and Mg^{27}. A.

539.14

1223. STATES IN O^{16} BETWEEN 12.67 AND 13.80 MeV. F.B.Hagedorn.
Phys. Rev., Vol. 108, No. 3, 735-43 (Nov. 1, 1957).

A study of the elastic scattering of protons from N^{15} is reported for proton energies between 600 and 1800 keV and for scattering angles from 75° to 160°. The technique for the preparation of the N^{15} targets is discussed. Anomalies in the scattering cross-section are observed near incident proton energies of 710, 898, 1028, 1210, and 1640 keV, corresponding to states in O^{16} from 12.78 to 13.65 MeV. Analysis of these scattering data leads to the assignments $J = 0^-$, $J = 2^-$, $J = 1^-$, $J = 3^-$, and $J = 1^+$ for the 710, 898, 1028, 1210, and 1640 keV states respectively. These assignments agree with earlier work except for the 710 keV resonance, which is reported here for the first time, and the 1210 keV level, which was previously reported to be $J = 4^+$. The angular distribution of the α-particles resonant at 1210 keV from the reaction $N^{15}(p,\alpha_1\gamma)C^{12}$ was remeasured and requires $J = 4^+$ as was found previously. However, a measurement of the $\alpha-\gamma$ angular correlation function at 1210 keV is found to be consistent with $J = 3^-$ but not $J = 4^+$. This discrepancy has not been resolved, but the evidence favouring the assignment $J = 3^-$ is quite strong. Suggestions for the isotopic spin quantum numbers for these five states in O^{16} are made. A.

539.14 : 539.163.2

1224. EXCITED LEVELS OF CADMIUM 110. A.C.Knipper.
Proc. Phys. Soc., Vol. 71, Pt 1, 77-81 (Jan., 1958).

The γ-rays in the decay of Ag^{110} have been observed using scintillation counters. A simplified decay scheme is presented. Spin assignments for the levels of Cd^{110} and mixing ratios of the γ-rays are obtained from the comparison of angular correlations in the double and triple cascades. A.

539.14 : 539.17

1225. THE REACTION ^{24}Mg(p,γ)^{25}Al AT THE 418 keV RESONANCE. J.Varma and W.Jack.
Proc. Phys. Soc., Vol. 71, Pt 1, 100-8 (Jan., 1958).

The 421 ± 4 keV proton-capture resonance in Mg^{24} has been studied employing scintillation counters. The resonance has a width of less than 1 keV, and the relative intensities of the resulting gamma-radiations of energies 2.71, 2.26, 1.81, 1.36 and 0.89 MeV are as 1:1.5:0.4:0.5:2.2 respectively. Coincidence experiments show that the 2.71 MeV level in Al^{25} decays to the ground, 0.453 and 1.81 MeV states. The 1.81 MeV level decays to the ground and first two excited states. The second excited state at 0.94 MeV decays in part through the emission of a 0.49–0.45 MeV γ-ray cascade. Measurements of the angular distribution of the gamma rays establish the spin of the resonance level to be $\frac{5}{2}^+$, and the ground state transition to be a mixture of M1 and E2 radiations. The 2.26 MeV transition to the first excited state is probably pure M1. The spin of the 1.81 MeV state is indicated to be $\frac{5}{2}^+$, which is consistent with the results of triple angular-correlation measurements of the 0.90–1.36 MeV gamma-ray cascade. A.

539.14 : 539.163.1

1226. NUCLEAR GAMMA RAY RESONANCE IN ^{48}Ti. V.Knapp.
Proc. Phys. Soc., Vol. 71, Pt 2, 194-200 (Feb., 1958).

The resonance scattering of the V^{48} 990 keV gamma-rays in titanium was observed using the recoil of the previous transition to restore the recoil losses. From the measured scattering cross-section, the mean life of the 990 keV level was found to be $(6 \pm 2) \times 10^{-12}$ sec, which is rather shorter than the Coulomb excitation value. Extending the comparison of mean lives as obtained by the two methods to other even–even nuclei, the same discrepancy is found in all available cases. A.

RADIOACTIVITY

539.16.08

1227. RADIOCARBON DATING IN TRONDHEIM. R.Nydal and R.S.Sigmond.
Appl. sci. Res. B, Vol. 6, No. 5, 393-400 (1957).

Naturally occurring radiocarbon (C^{14}) is registered in a proportional counter filled with pure CO_2. The CO_2 gas is purified in almost the same manner as has been developed by De Vries and Barendsen (Physica, Vol. 19, 63, 1953). Checking of the gas purity is described. A grid proportional counter with an effective volume of about 2.5 litres has been used with CO_2 pressures from 1 to 4 atm. At a pressure of 4 atm the net count from contemporary wood is 58 counts/min above a background of 15 counts/min. Dating may at the present stage be extended to 35 000 years by 24 hours counting at a pressure of 4 atm CO_2. A method for checking the discriminating level of the counting apparatus is described. A.

539.16.08

1228. THE REMOVAL OF RADON FROM CO_2 FOR USE IN ^{14}C AGE MEASUREMENTS. H.L. de Vries.
Appl. sci. Res. B, Vol. 6, No. 6, 461-70 (1957).

It is shown that traces of radon can be extracted from carbon dioxide by pumping off from solid CO_2. Since the volatility of radon is smaller than the volatility of CO_2, special care has to be taken during condensation in order to avoid occlusion. Enrichment of radon at the wall where the CO_2 condenses is avoided by stirring the gas. An estimate of the fraction of radon, adsorbed on the wall, demonstrates the necessity of performing the condensation at about −80° C. At −180° C the greater part of the radon is adsorbed; consequently it is occluded if CO_2 is added. The method can be used only in those cases where the volatility of the contaminant is not too much lower than of CO_2, and where the molecules of the contaminant do not fit well into the lattice of solid CO_2. The present purification is much faster than the chemical purification used earlier by the author. A.

539.16.08

1229. RADIATION-FLUX CONDITIONS IN RADIOACTIVE MEDIA WITH APPLICATIONS TO RADIATION MONITORING. B.E.Dahlin.
Trans Amer. Inst. Elect. Engrs I, Vol. 76, 391-6 (1957) = Commun. and Electronics, No. 32 (Sept., 1957).

Calculations are made for the radiation flux in a radioactive medium. The scattering effects are treated with a simplified model giving an easy survey of the total flux media with various densities and various atomic weights. The calculations are used for comparison of the sensitivities of common detectors for radiation monitoring of air-borne and water-borne radioactivity. The results are in diagrams compared with the stipulated tolerances of radioactivity in those media for the common isotopes. A.

539.163

1230. SPECTRA OF THE ABNORMALLY LONG [RANGE] PARTICLES EMITTED BY ACTIVE DEPOSITS OF Po^{210} AND Pu^{239}. M.Ader, M.P.Cabannes and P.Conte.
J. Phys. Radium, Vol. 18, No. 7, 475-6 (July, 1957). In French.

539.163

1231. THE NEW ELEMENT NOBELIUM. H.A.C.McKay; J.Milsted.
Nature (London), Vol. 180, 1010-12, 1012-13 (Nov. 16, 1957).

The production of transuranic elements by means of α-particle, neutron, and heavy-ion bombardment is reviewed. The preparation of nobelium is described. A Cm^{244} target was bombarded by C^{13} ions in a cyclotron and 17 α-particles from No^{251} or No^{253} were counted. The source of the α-particles was decided by their energy (8.5 MeV) and half-life (~10 min), and by chemical tests. See also Abstr. 317 (1958). J.M.Cassels

539.163

1232. ON THE DECAY OF ^{113}Sn AND ^{121}Te. K.S.Bhatki, R.K.Gupta, S.Jha and B.K.Madan.
Nuovo Cimento, Vol. 6, No. 6, 1461-8 (Dec., 1957).

By coincidence studies of Sn^{113} and by studying Sn^{113} sources completely separated from In^{113}, the existence of a level at 650 keV in Sn^{113} resulting in the emission of 258 keV γ-ray is established. This state is fed by the electron capture transition in Sn^{113} to the extent of about 3.5%. The decay energy of Sn^{113} leading to the 650 keV state is calculated to be 36 keV. In the decay of Te^{121m} and Te^{121} γ-rays of energy 70 keV and 1130 keV were observed. A.

539.163

1233. THE DECAY OF LONG-LIVED HOLMIUM 166. M.A.Grace, R.T.Taylor and P.B.Treacy.
Phil. Mag. (Eighth Ser.), Vol. 3, 90-6 (Jan., 1958).

The decay of long-lived Ho^{166} is discussed and results are given which suggest that the 817 and 718 keV γ-rays are each in competition with separate cascade pairs of energies 537 + 280 keV and 438 + 280 keV respectively. A level scheme is proposed consistent with the existence of a low lying rotational spectrum in the product nucleus Er^{166}. A.

539.163

1234. DECAY OF Ca^{38}. J.E.Cline and P.R.Chagnon.
Phys. Rev., Vol. 108, No. 6, 1495-6 (Dec. 15, 1957).

The decay of a new isotope, Ca^{38}, produced by the reaction $Ca^{40}(\gamma,2n)$, was observed via branching of the beta decay to a 3.5 MeV excited state of K^{38}. The observed half-life of (0.66 ± 0.05) sec is consistent with a log (ft) value of 3.5 for the ground-state transition. The tentative assignment for the K^{38} excited state is $J = 1^+$, $T = 0$ although $J = 0^+$, $T = 1$ is also possible. A search for branching in the decay of S^{30} is also discussed. A.

539.163.1

1235. LIFETIME MEASUREMENTS BY CONVERSION LINE SHIFT: LIFETIME OF THE 40 keV STATE OF Tl^{208}. J.G.Siekman and H.de Waard.
Phys. Rev., Vol. 107, No. 6, 1731 (Sept. 15, 1957).

Experiments on the penetration of Tn gas into foils indicate that the lifetime measurements of Burde and Cohen (Abstr. 2578/1957) may need correcting. The revised value of the lifetime of the 40 keV state in Tl^{208} is 4×10^{-12} sec. L.L.Green

539.163.2 : 539.14

DECAY SCHEME OF Ag^{110}. See Abstr. 1224

539.164

1236. STATISTICAL THEORY OF COUNTING OF ALPHA-PARTICLES EMITTED BY SUCCESSIVE DISINTEGRATIONS OF RADIOACTIVE ELEMENTS. M.Huybrechts.
Nuovo Cimento, Vol. 6, No. 4, 811-31 (Oct., 1957). In French.

539.164

1237. TABLE OF ALPHA-DISINTEGRATION ENERGIES OF THE HEAVY ELEMENTS. F.Asaro and I.Perlman.
Rev. mod. Phys., Vol. 29, No. 4, 831-6 (Oct., 1957).

This is a revision of a table previously published (Abstr. 2101/1955).

539.164.08

1238. STUDY ON α RADIOACTIVITY IN LOW CONCENTRATION. R.D.Lonati, U.Facchini, I.Iori, F.G.Houtermans and E.Tongiorgi.
Nuovo Cimento, Vol. 7, No. 2, 133-41 (Jan. 16, 1958).

With an ionization chamber filled with A (98%) and N_2 (2%) and with an emitting surface of 1100 cm^2 it is possible to analyse by means of their α-spectra, samples of radioactive material containing up to concentrations of about 10^{-5} units. These investigations are useful for instance, in the study of the age of a mineral deposit or a fossil; in the study of ocean sediments and of the radioactivity of lava. A.

539.165 : 539.166

1239. BETA—GAMMA DIRECTIONAL CORRELATION IN ^{170}Tm. G.Bertolini, E.Lazzarini and M.M.Bettoni.
Nuovo Cimento, Vol. 6, No. 5, 1106-12 (Nov., 1957).

The existence is confirmed of angular correlation between the β-rays belonging to decay of 889 keV maximum energy of Tm^{170} and the 84 keV γ-rays of Yb^{170}. The differential angular correlation was measured. By means of a magnetic beta-spectrometer and $\beta-\gamma$ coincidences the shape of the low-energy β-spectrum of Tm^{170} was studied. The results are in agreement with an assignment 1− to the ground state of Tm^{170}. Under this hypothesis, the ratios of nuclear matrix elements effective in the β transition were found which were in best agreement with the experimental data. A.

539.165

1240. THE POSITRON DECAY OF THE GROUND STATE OF ALUMINIUM-26. P.S.Fisher, D.W.Hadley and G.Speers.
Phil. Mag. (Eighth Ser.), Vol. 3, 163-9 (Feb., 1958).

An investigation has been made of the long-lived ground state of Al^{26}. The gamma-ray spectrum has been determined with a scintillation spectrometer, and the half-life calculated both by comparing the ratio of the masses of Al^{26} and Al^{27} in the source and by comparison of reaction cross-sections, the value obtained being 0.8×10^6 years (±30%). The positron spectrum, measured using an overcompression cloud chamber, is consistent with that expected for a unique second forbidden transition, thus helping to confirm that the ground state of Al^{26} is a 5+ level, decaying to a 2+ excited level in Mg^{26}. An appendix describes the radiochemical separation procedure for extraction of the active aluminium from the magnesium targets. A.

539.165 : 539.166

1241. ANGULAR CORRELATIONS BETWEEN β RAYS AND CIRCULARLY POLARIZED γ RAYS IN TRIPLE CASCADE TRANSITIONS. M.Morita.
Phys. Rev., Vol. 107, No. 6, 1729-30 (Sept. 15, 1957).

The angular correlations between β-rays and circularly polarized γ-rays for triple cascade transitions may furnish information concerning the relative magnitudes and phases of the ten coupling constants of β interactions. These angular correlations are calculated for: (1) The β-ray and the circularly polarized γ^1 without observing γ^2, and (2) The β-ray and the circularly polarized γ^2 without observing γ^1. Expressions are given assuming that strong interactions are invariant under time-reversal; and assuming that they are variant under time-reversal. In all the cases calculated it is assumed that the β interactions do not conserve parity. D.R.Chick

539.165

1242. POLARIZATION OF POSITRONS FROM N^{13}: A MIXED TRANSITION. S.S.Hanna and R.S.Preston.
Phys. Rev., Vol. 108, No. 1, 160-1 (Oct. 1, 1957).

The longitudinal polarization of positrons from a mixed transition (N^{13}), in which 70% of the decays are through the Fermi interaction, was studied by two quantum annihilation in magnetized iron. Comparison with a pure Gamow—Teller transition (Cu^{64}) showed that both the sign and magnitude of the polarization are similar for the two transitions. M.A.Grace

539.165

1243. ABSENCE OF INTERFERENCE EFFECTS IN THE β-DECAY OF POLARIZED Co^{56} AND Co^{58} NUCLEI. E.Ambler, R.W.Hayward, D.D.Hoppes and R.P.Hudson.
Phys. Rev., Vol. 108, No. 2, 503-5 (Oct. 15, 1957).

The asymmetry coefficients for the angular distribution of

β^+-particles from polarized Co^{56} and Co^{58} nuclei are 0.221 ± 0.021 and 0.325 ± 0.047 and both these values are inconsistent with mixed β-transitions (Abstr. 2549/1957) unless the interference terms are imaginary quantities. The presence of these imaginary terms was looked for in β–γ angular correlation experiments with polarized Co^{58} nuclei: these showed negligible backward—forward asymmetry and are in accord with the β-transition being pure. M.A.Grace

539.165

1244. TABLE OF TOTAL BETA-DISINTEGRATION ENERGIES. II. L.J.Lidofsky.
Rev. mod. Phys., Vol. 29, No. 4, 773-830 (Oct., 1957).

Pt I (Abstr. 2098/1955) has been used widely as a data summary and as a source for evaluating mass differences. A great deal of new data has since appeared in the literature and information available up to about March, 1957, is included in the present report. A.

539.165.2

1245. THE β-DECAY INTERACTION FROM THE EXPERIMENTAL DATA ON β-RECOIL-NUCLEUS ANGULAR CORRELATION. Vinh Mau.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2256-9 (Dec. 16, 1957). In French.

An attempt is made to find the form of the β-decay interaction, in as far as it is determined by β—ν angular correlation experiments alone. By taking all the published results and slightly increasing the stated errors, a best fit is obtained with an interaction which contains S, V, T and A terms. J.C.Taylor

539.165.2

1246. POLARIZATION EFFECTS IN BETA DECAY ACCOMPANIED BY INTERNAL BREMSSTRAHLUNG. J.Sawicki and J.Szymanski.
Nuovo Cimento, Vol. 6, No. 4, 982-4 (Oct., 1957).

539.165.2

1247. COUPLING CONSTANT INVARIANTS IN β-DECAY. S.Kahana and D.L.Pursey.
Nuovo Cimento, Vol. 6, No. 6, 1469-79 (Dec., 1957).

The principle used by Pauli and Pursey is extended and applied to single β-decay without lepton conservation, and to β-decay with non-vanishing neutrino mass. Identities are found between the coupling constant invariants for Pauli's general interaction, and it is shown that these involve at most 35 independent real constants. Conditions are given for invariance under space inversion, time reversal, particle—antiparticle conjugation, and for four interesting special theories, including lepton conservation and the two-state neutrino theory. A brief discussion is given of how experimental knowledge of the invariants, in particular those occurring in single β-decay, can be used to check the various special cases. A.

539.165.2

1248. ON THE PURSEY—PAULI INVARIANTS IN THE THEORY OF BETA DECAY. G.Lüders.
Nuovo Cimento, Vol. 7, No. 2, 171-89 (Jan. 16, 1958).

The assumption of a vanishing neutrino mass leads to a group of transformations on the neutrino field which transform the β-decay interaction into equivalent interactions. By physical observations one cannot distinguish between equivalent interactions. The results of observations can be expressed in terms of nuclear matrix elements and combinations of the coupling constants which are invariant under the group. These invariants have been put forward by Pursey and on a more general basis by Pauli (Abstr. 8397/1957). They are explored further in this paper. Their mathematics is studied and relations between them are established. The conditions for invariance with respect to reflections in space, charge conjunction, and time reversal are expressed in terms of these invariants. Interactions which conserve lepton charge and/or couple to only two components of the neutrino field are characterized by relations between the invariants. In the appendix possible experiments on β-decay are expressed in terms of the invariants. A.

539.165.2

1249. PARITY NONCONSERVATION AND THE β SPECTRUM OF RaE. J.-I.Fujita, M.Yamaba, Z.-I.Matumoto and S.Nakamura.
Phys. Rev., Vol. 108, No. 4, 1104-6 (Nov. 15, 1957).

If the Gamow—Teller component of the β-decay interaction is of the tensor type and if $C_T = -C_T'$, it is very difficult to explain the β spectrum of RaE unless: (a) the Fermi interaction is of the scalar type, (b) $C_S = -C_S'$, and (c) C_S/C_T is real. J.C.Taylor

539.166

1250. THE ANGULAR CORRELATION OF THE GAMMA CASCADE IN SULPHUR 34. P.S.Fisher and G.G.Shute.
Phil. Mag. (Eighth Ser.), Vol. 2, 1255-63 (Oct., 1957).

This was measured and found to be $1 + (0.332 \pm 0.032)P_2(\cos\theta) - -(0.017 \pm 0.011)P_4(\cos\theta)$ and this is interpreted in terms of a spin-sequence 2^+, 2^+, 0 with a mixture of 1.4% of E2 radiation in the first transition. A new angular correlation apparatus and fast coincidence system is briefly described. A.

539.166

1251. DELAYED γ-RAY ANGULAR CORRELATIONS IN TANTALUM 181. R.E.Azuma and G.M.Lewis.
Phil. Mag. (Eighth Ser.), Vol. 2, 1325-32 (Nov., 1957).

The anisotropy of the 133-480 keV γ-ray cascade in Ta^{181} was investigated for liquid sources, using a time-sorting coincidence unit of short resolving time. The maximum anisotropy was found to be $-(39 \pm 3)\%$, consistent with the $\frac{1}{2}$(E2) 5/2 (E2 + M1) 7/2 assignment; and evidence was obtained for attenuation of the correlation in liquid sources. A.

539.166.08

1252. CONVERSION PROCESSES USED IN HIGH PRECISION GAMMA-RAY SPECTROSCOPY. D.B.Beard.
Rev. sci. Instrum., Vol. 28, No. 9, 724-5 (Sept., 1957).

Discusses the relative advantages of the three conversion processes (photoelectric, Compton and pair-production) when using a high-resolution β-ray spectrometer for γ-ray spectroscopy. For a heavy element convertor the Compton effect is far less efficient than the other two processes and for these the author deduces a formula showing the energy above which the pair-production process is superior to the photoelectric effect. L.E.Mussell

539.166.2 : 539.14

1253. ANGULAR CORRELATIONS OF GAMMA RAYS IN ^{103}Rh. F.C.Flack and P.Mason.
Proc. Phys. Soc., Vol. 71, Pt 2, 247-51 (Feb., 1958).

Lifetime measurements indicate that the 55 keV transition in Rh^{103} is mostly dipole in character. Angular correlation measurements involving this transition rule out $\frac{5}{2}^+$ for the spin of the level at 538 keV, but allow $\frac{7}{2}^+$ or $\frac{9}{2}^+$, the former being preferred. The spin of the 650 keV level is not determined by these results. A.

NUCLEAR REACTIONS

539.17 : 539.14

REACTIONS $Mg^{24}(d,p)Mg^{25}$ AND $Mg^{26}(d,p)Mg^{27}$. See Abstr. 1222

539.17

1254. TIME REVERSAL IN NUCLEAR INTERACTIONS. E.M.Henley and B.A.Jacobsohn.
Phys. Rev., Vol. 108, No. 2, 502-3 (Oct. 15, 1957).

From a survey of nuclear reactions and angular correlations it is concluded that nuclear forces which are odd with respect to time reversal may be present with a strength of up to 20%. Other experiments which might test time reversal invariance are discussed. M.A.Grace

539.17

1255. STUDY OF THE B^{11} + p REACTIONS. G.Dearnaley, G.A.Dissanaike, A.P.French and G.L.Jones.
Phys. Rev., Vol. 108, No. 3, 743-53 (Nov. 1, 1957).

Describes a detailed study of the $B^{11}(p,\alpha_0)Be^8$, $B^{11}(p,\alpha_1)Be^{8*}(2\alpha_2)$ and $B^{11}(p,p)$ processes for the region of proton energies spanning the resonances at 0.67 MeV and 1.4 MeV. The measurements include excitation functions and angular distributions, together with the angular correlation between α_1 and α_2 as inferred from the alpha-particle energy spectrum in fixed geometry. The results are analysed theoretically and are discussed in relation to the findings of other investigators. It is concluded that the complete body of data can be accounted for if the 0.67 MeV resonance (16.57 MeV state of C^{12}) is (2^-) and the 1.4 MeV resonance (17.22 MeV state of C^{12}) is (1^-), both formed mainly by s-wave protons; this would corroborate the preferred assignments previously suggested. The proton elastic scattering data imply that the ratio Γ_p/Γ is 0.5 for the 0.67 MeV resonance and 0.05 for the 1.4 MeV resonance. A.

539.17

1256. $Li^7(p,n)$, $(p,p'\gamma)$, AND (p,γ) REACTIONS NEAR NEUTRON THRESHOLD. H.W.Newson, R.M.Williamson, K.W.Jones, J.H.Gibbons and H.Marshak.
Phys. Rev., Vol. 108, No. 5, 1294-300 (Dec. 1, 1957).

The $Li^7(p,n)$ total cross-section was measured in detail from threshold to 2.5 MeV proton energy. Between 1.88 and 1.92 MeV the cross-section follows the equation for a very broad 2^- resonance and for s-wave particles: $\sigma_{pn} = (5/2)\pi\lambda^2 x/(1+x)^2$, where $x = \Gamma_n/\Gamma_p = 1$ at 50 keV above threshold. The remainder of the cross-section up to 2.35 MeV is fitted by this level and the 3^+ level at 2.25 MeV. The neutron reduced width exceeds that of the proton by a factor of about five for both the 2^- and 3^+ levels; this is surprising for the self-mirror nucleus Be^8. A small dip is observed just above neutron threshold in the yield of 478 keV gamma-rays from $Li^7(p,p'\gamma)$. The shape of these data support the assumption of the broad 2^- neutron producing resonance with $\Gamma_p > 0.5$ MeV. No anomaly is observed in the yield of Li capture gamma-rays at neutron threshold; the 2.10 MeV resonance in this reaction (which probably is due to a $3^\pm$ level) yields mainly 16 MeV gamma-rays leading to the 2.9 MeV $2^\pm$ level in Be^8. The ratio of 16 to 19 MeV gamma-rays is $\frac{3}{2}$ at both 1.7 and 2.5 MeV proton energy. The behaviour of the $Li^7(p,n)$ extrapolated threshold was calculated as a function of target thickness and proton energy spread; shifts in the extrapolated thresholds and the distances between them and true threshold were less than one keV. The extrapolated threshold of a $\frac{1}{2}$ keV target taken with a proton energy spread of 1 keV was observed to be $\frac{1}{2}$ keV lower in proton energy than a thick-target threshold. A.

539.17

1257. STUDY OF THE $T(p,n)He^3$ AND $Li^7(p,n)Be^7$ REACTIONS. R.L.Macklin and J.H.Gibbons.
Phys. Rev., Vol. 109, No. 1, 105-9 (Jan. 1, 1958).

Absolute total (p,n) cross-sections for the $T(p,n)He^3$ and $Li^7(p,n)Be^7$ reactions were remeasured from threshold to 2.4 MeV, with special attention to the cross-section near threshold. The $T(p,n)He^3$ total cross-section follows the behaviour expected from either direct interaction or Breit–Wigner analysis over most of the range studied. Departure from predicted behaviour occurs below $E_p(lab) = 1.10$ MeV. The $Li^7(p,n)Be^7$ cross-section can be fitted over the entire energy range studied by assuming a broad 2^- resonance near threshold, a 3^+ resonance at 2.25 MeV, and a small reaction background due to distant $l = 1$ resonances. The usual assumption of equal reduced widths for neutron and proton, however, cannot be used. Data for both reactions extrapolate to the values determined by reciprocity from the inverse reactions with thermal neutrons. A.

539.17

1258. ELASTIC SCATTERING OF 96 MeV PROTONS. G.Gerstein, J.Niederer and K.Strauch.
Phys. Rev., Vol. 108, No. 2, 427-32 (Oct. 15, 1957).

The elastic scattering of 96 MeV protons from C, Al, Cu, Ag, Ta, Pb, and Th was investigated at laboratory angles between 3^0 and 60^0. A range telescope with an over-all energy resolution of 2.8 MeV was used to obtain the energy distribution of scattered protons at each angle of observation. The energy distributions are analysed to obtain values for (1) an "upper limit" to the elastic cross-section which includes slightly inelastic events, and (2) an "extrapolated" elastic cross-section in which inelastic events are subtracted by an extrapolation procedure. All targets show diffraction minima and Coulomb-nuclear interference effects. The depth of the diffraction minima in general increases with atomic number, except that Ta and Th have less pronounced minima than either Ag or Pb. A.

539.17 : 539.12

HIGH-ENERGY PROTON–NUCLEAR SCATTERING.
See Abstr. 1172

539.17 : 539.14

REACTION $^{24}Mg(p,\gamma)^{25}Al$ AT THE 418 keV RESONANCE.
See Abstr. 1225

539.17

1259. INELASTIC SCATTERING OF FAST NUCLEONS BY LIGHT NUCLEI. INFLUENCE OF THE COMPLEX POTENTIAL. P.Benoist, C.Marty and P.Meyer.
C.R. Acad. Sci. (Paris), Vol. 245, No. 17, 1389-91 (Oct. 21, 1957). In French.

The differential cross-sections for inelastic scattering at 90-185 MeV by excitation of the 4.43 MeV state of C^{12} is calculated taking into account the effect of a complex potential on the incident proton wave. Between 10^0 and 50^0 the angular distribution is very little different from that previously obtained by Born approximation (Abstr. 7369/1957). L.L.Green

539.17

1260. THE REACTION $^3He(d,p)^4He$ BETWEEN 100 keV AND 500 keV. D.L.Booth, R.S.Hill, F.V.Price and D.Roaf.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 863-5 (Dec., 1957).

The cross-section was investigated between 100 keV and 500 keV deuteron energy, using a thin gas target. No significant ansiotropy was found up to 500 keV. The total cross-sections σ at deuteron energies E_d assuming isotropic angular distributions were

E_d	503.2	402.6	301.9	201.3	110.7
σ	0.476 ± 0.008	0.606 ± 0.050	0.482 ± 0.040	0.15 ± 0.01	0.023 ± 0.001

where E_d is in keV and σ in barns. A.

539.17 : 539.14

1261. AN INVESTIGATION OF THE $^{16}O(d,\alpha)^{14}N$ REACTION BY MAGNETIC ANALYSIS. A.W.Dalton, S.Hinds and G.Parry.
Proc. Phys. Soc., Vol. 71, Pt 2, 252-6 (Feb., 1958).

The $O^{16}(d,\alpha)N^{14}$ reaction has been investigated by bombarding energies of 6.8, 7.1, 7.2 and 8.9 MeV. At these energies the intensity of the transition to the 2.31 MeV, T = 1 state of N^{14} has been measured. Angular distributions have been obtained for the alpha-particles leading to the ground state and the 3.95 MeV level of N^{14} for bombarding energies of 6.8 and 8.9 MeV. A.

539.17

1262. ELASTIC SCATTERING OF ALPHA PARTICLES AND DEUTERONS FROM HEAVY NUCLEI. J.R.Rees and M.B.Sampson.
Phys. Rev., Vol. 108, No. 5, 1289-93 (Dec. 1, 1957).

The angular distributions of 22 MeV alpha-particles and 11 MeV deuterons scattered elastically from Ta, Au, Bi, and U were measured at angles of 20^0 to 160^0 in the laboratory system. It is found in all cases that the deuteron cross-sections depart from the Rutherford angular dependence at smaller angles than the alpha-particle cross-sections for the same nuclei, indicating electric breakup of the deuteron. A.

539.17

1263. FURTHER INTERACTIONS OF THE HEAVY NUCLEI OF THE COSMIC RADIATION. V.Y.Rajopadhye and C.J.Waddington.
Phil. Mag. (Eighth Ser.), Vol. 3, 19-32 (Jan., 1958).

Earlier results obtained from a study of nuclear interactions produced by heavy nuclei of the primary cosmic radiation passing through nuclear emulsions have been amplified and confirmed. Revised values are given for the fragmentation probabilities and mean free paths which are of greater statistical weight and in good agreement with those reported previously. Values are derived from the fragmentation probabilities in air and in hydrogen which probably represent upper limits to the true values. The implications of the results are discussed. A.

539.17

1264. NEUTRON POLARIZATION FROM ELECTRON DISINTEGRATION. M.Suffczyński.
Nuovo Cimento, Vol. 6, No. 6, 1268-72 (Dec., 1957).

The polarization of neutrons from disintegration of the deuteron by fast electrons is calculated in dipole approximation. A.

539.17

1265. PHOTODISINTEGRATION OF THE ALPHA PARTICLE. B.H.Bransden, A.C.Douglas and H.H.Robertson.
Phil. Mag. (Eighth Ser.), Vol. 2, 1211-18 (Oct., 1957).

The cross-section for the two particle, $He^4(\gamma,p)H^3$, photodisintegration of the alpha-particle is calculated, taking into account the interaction between the proton and triton in the final state. It is shown that this is insufficient to remove the discrepancy between the experimental cross-section, and cross-sections calculated with wave-functions that are consistent with the binding energy of the alpha-particle, even when the tensor force is included in the two body interaction. A.

539.17

1266. GAMMA-RAY SPECTRUM DUE TO THE INELASTIC SCATTERING OF 2.5 MeV NEUTRONS IN IRON. P.Eberhard, J.Garg and B.Torki.
C.R.Acad. Sci. (Paris), Vol. 245, No. 17, 1415-18 (Oct. 21, 1957). In French.

A scintillation counter was used to detect γ-radiation excited by D+D neutrons in a ring-shaped scatterer of Fe surrounding the scintillation crystal. Gamma-rays of energies 0.845, 1.25, 1.40, 1.70, 1.83 and 2.15 MeV were found. M.A.Grace

539.17 : 539.12

1267. THE PROTONS EMITTED FROM IRON-54 AND IRON-56 ON BOMBARDMENT WITH 13.5 MeV NEUTRONS.
P.V.March and W.T.Morton.
Phil. Mag. (Eighth Ser.), Vol. 3, 143-51 (Feb., 1958).

Energy spectra and angular distributions of protons emitted from the isotopes Fe^{54} and Fe^{56} on bombardment with neutrons with an energy of 13.5 MeV have been studied using photographic emulsions. The angular distributions of protons with energy greater than 7 MeV show a marked forward peak suggesting the occurrence of direct interaction. A.

539.17

1268. ELASTIC SCATTERING OF 3.1 MeV POLARIZED NEUTRONS.
B.M.McCormac, M.F.Steuer, C.D.Bond and F.L.Hereford.
Phys. Rev., Vol. 108, No. 1, 116-19 (Oct. 1, 1957).

By using a partially polarized neutron beam from the $D(d,n)He^3$ reaction, the elastic scattering polarization of a number of elements was observed. For Be and C scatterers, the angular dependence of the polarization can be correlated with parameters characterizing compound-nucleus levels excited by the incident neutrons. For medium and heavy scattering nuclei, the observed polarization is in poor agreement with the few existing optical-model calculations for 3.1 MeV neutrons. With the exception of Pb, all medium and heavy elements studied yielded positive polarization in the 30^0-60^0 range of scattering angles, i.e., they would produce polarization in the direction $k_n \times k_{n'}$ in single scattering events. A.

539.17

1269. INTERACTIONS OF LOW-ENERGY NEGATIVE PIONS WITH NUCLEI. N.Byers.
Phys. Rev., Vol. 107, No. 3, 843-9 (Aug. 1, 1957).

A boundary condition method is used to correlate the level shifts in π-mesonic atoms with the scattering of slow pions by light nuclei; carbon is chosen as an example. Up to 5 MeV kinetic energy, the s-phase-shifts are dominant and a calculation of the scattering cross-section is possible without much ambiguity. In the absence of sufficient experimental data on the p-level shifts, a best estimate is attempted in order to include p-wave scattering and to extend the predictions up to 10 MeV kinetic energy. A.

539.17 : 539.166

1270. THE GAMMA-RAYS FROM MUON CATALYSED FUSION OF HYDROGEN AND DEUTERIUM.
A.Ashmore, R.Nordhagen, K.Strauch and B.M.Townes.
Proc. Phys. Soc., Vol. 71, Pt 2, 161-72 (Feb., 1958).

The fusion of hydrogen and deuterium catalysed by muons was observed by Alvarez et al. (Abstr. 5651/1957). Events were seen in a bubble chamber in which the muon was re-emitted with the energy released in the fusion process. In the experiments described here the γ-rays from the fusion process were detected and a measurement made of their time distribution. The yield of γ-rays was found to be 0.34 ± 0.06 per muon stopping in liquid hydrogen enriched with 1.8% of deuterium. A comparison with the results of Alvarez et al. gives an internal conversion coefficient of 0.066 ± 0.014. The analysis of the time distribution enables the following limits to be set on the two reaction rates involved:

$$0.19 \times 10^6 \text{ sec}^{-1} < \lambda_{\text{slow}} < 0.88 \times 10^6 \text{ sec}^{-1}$$

$$0.55 \times 10^6 \text{ sec}^{-1} < \lambda_{\text{fast}} < 2 \times 10^7 \text{ sec}^{-1}.$$

A comparison with theory shows that it is not possible to assign them to particular processes in the chain of events following a muon stopping in the enriched mixture. A.

539.17

1271. E.B.W.R. — EXPERIMENTAL BOILING WATER REACTOR.
Nucleonics, Vol. 15, No. 7, 53-64, and chart facing 52 (July, 1957).

Nucleonics Reactor File No. 1. This is the first of a series of comprehensive descriptions of working reactors, incorporating a chart, equivalent to six pages, which gives a full description, working data, sketches and block diagrams. E.B.W.R. is an experimental heterogeneous direct boiling light-water nuclear power plant. It generates 20 MW of heat and 4.5 MW of electricity and is intended as a basis for the design of future power plants. The core is a 4 ft diameter right cylinder and contains 76 kg of U^{235} at 1.4% enrichment. There are 106 plate-type enriched-fuel elements clad in Zircalloy 2, and five hafnium and four boron steel absorbing rods controlling a total of 13% reactivity. The reactor pressure-vessel is 7 ft dia. and 23 ft long and operates at 800 lb/in^2 above atmospheric. It is contained in an outer cylindrical vessel 80 ft in diameter with an internal water spray to prevent steam pressure build-up as the result of any accident to the reactor. No critical experiments were carried out during the design stage but the first month of operation was devoted to the determination of the critical loading and other physics measurements. For future reactors it is thought that these measurements should be carried out on a zero-power assembly. The reactor first ran at power in December, 1956 and has since generated 5000 MWh of electricity. The plant has proved to be very reliable, simple to operate and easy to maintain. Stability against variation of steam demand is achieved using a bypass valve: resonance instability associated with the presence of voids may, however, prove to be a limitation to high-power reactors of this type. In the section entitled "Starting up E.B.W.R.", by J.W.Harrer, it is stated that starting the reactor from cold is possible, though there is some instability at the onset of boiling. Preheating results in a smoother start-up. Burst fuel plates are detected by a NaI : Th crystal monitoring the xenon activity in the air-ejector gas. The overall water leakage rate is 88 lb/day, about 60 lb/day being dissociated water leaving through the air ejector system. Power costs are estimated at 52 mils/kWh, but can probably be reduced to 15 mils/kWh. With a 500 MW reactor the cost might be reduced to 8 mils/kWh. R.D.Smith

539.17

1272. A.P.P.R. — ARMY PACKAGE POWER REACTOR.
Nucleonics, Vol. 15, No. 8, chart facing p. 60 (Aug., 1957).

Nucleonics Reactor File No. 2. The chart, equivalent to six pages, gives a full description, working data, sketches and block diagram. The Army Package Power Reactor is a pressurized water thermal reactor, containing 22.5 kg of U^{235}, generating 10 MW of heat and 2 MW electricity. The reactor is designed for erection at remote sites and has been operating since April, 1957. It has proved very stable in operation. R.D.Smith

539.17

1273. S.R.E. — SODIUM REACTOR EXPERIMENT.
Nucleonics, Vol. 15, No. 12, 37-40, and chart facing 36 (Dec., 1957).

Nucleonics Reactor File No. 3. The reactor is sodium-cooled and graphite-moderated and has an output of 20 MW of heat. Full data are given together with an account of the initial start-up ("Starting up S.R.E.", by F.E.Faris, 37-9). Initial power runs have shown that the reactor is stable and that the use of sodium as a coolant is proving successful. The reactor has an overall positive temperature coefficient, but the prompt power coefficient is negative. Further detailed measurements of the temperature coefficients are planned. The fuel elements are of unalloyed uranium in stainless steel cans. Tests will be made on various fuel element designs using alloys including U—Th, U—Mo, and U—Zr, and also ceramic materials. R.D.Smith

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

ATOMS.

539.18 : 533.15

SEPARATION OF SULPHUR ISOTOPES BY THERMAL DIFFUSION OF SO_2. See Abstr. 907

539.18

1274. SUPPLEMENTARY INTEGRALS OF MOTION FOR THE HYDROGEN ATOM. Yu.A.Dobronravov.
Vestnik Leningrad. Univ., Ser. Fiz. Khim., 1957, No. 10, 5-10.
In Russian, with summary in English.

The paper deals with the symmetry of the Hamiltonian in the Schrödinger equation for the hydrogen atom. In addition to integrals of angular momentum, three further quantum-mechanical integrals of motion are obtained. C.R.S.Manders

539.18

1275. EXPLICIT SOLUTION OF THE PAULI EQUATION IN THE HYDRODYNAMIC REPRESENTATION FOR THE CASE OF THE HYDROGEN ATOM. P.Hillion.
C.R. Acad. Sci. (Paris), Vol. 245, No. 18, 1516-18 (Oct. 28, 1957).
In French.

539.18

1276. CAUSAL INTERPRETATION OF THE THEORY OF THE HYDROGEN ATOM, USING THE HYDRODYNAMIC REPRESENTATION OF THE PAULI EQUATION. P.Hillion.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1595-7 (Nov. 4, 1957). In French.

A causal physical interpretation is given to the solution found in the preceding abstract. R.J.N.Phillips

539.18

1277. PARAMAGNETIC RESONANCE, IN THE 10 000 Mc/s REGION, OF EUROPIUM AND GADOLINIUM SUBJECTED TO A CUBIC CRYSTALLINE FIELD. C.Ryter.
Helv. phys. Acta, Vol. 30, No. 5, 353-73 (1957). In French.

Circuit details are given for the spectrometer at 10 000 Mc/s with stabilization of the klystron and the magnetic field. The spectra of Gd^{3+} and Eu^{2+} in the $^8S_{7/2}$ ground states in single crystals of CaF_2 were observed and interpreted. The total Stark splittings of the state are 0.1491 ± 0.0008 and 0.1784 ± 0.0009 cm^{-1}, and the interlevel splitting ratio is approximately 3/5, the exact values being 0.596 ± 0.002 and 0.612 ± 0.003 and the g values are 1.9918 ± 0.0010 and 1.9927 ± 0.0010 for the Gd and Eu ions respectively. The Gd hyperfine structure is not fully resolved, but for the Eu isotopes the couplings are $K_{151} = 32.62 \pm 0.10$ and $K_{153} = 16.23 \pm 0.10$ gauss with $\mu_{151}/\mu_{153} = 2.26 \pm 0.02$. D.H.Whiffen

539.18

1278. THEORY OF THE PARAMAGNETIC RESONANCE OF EUROPIUM AND GADOLINIUM SUBJECTED TO A CUBIC CRYSTALLINE FIELD. R.Lacroix.
Helv. phys. Acta, Vol. 30, No. 5, 374-94 (1957). In French.

The theory of the electron resonance spectra of Gd^{+++} and Eu^{++} is developed including the departure from Russell–Saunders coupling and second-order effects of the fine structure upon the hyperfine structure. D.H.Whiffen

539.18 : 538.222

1279. MAGNETIC SUSCEPTIBILITIES OF URANIUM (IV) IONS IN CUBIC CRYSTALLINE FIELDS.
C.A.Hutchison, Jr and G.A.Candela.
J. chem. Phys., Vol. 27, No. 3, 707-10 (Sept., 1957).

The magnetic susceptibility arising from the electrons outside closed shells of U^{+4} in ditetramethylammonium uranium hexachloride was found to be 19.31×10^{-4} cm^3.mole^{-1} independent of temperature from room temperature down to the triple point of H_2. This result is discussed in terms of a ground-state configuration f^2 perturbed by the crystalline field. The measurements of others on uranium dioxide are also considered. A.

539.18 : 537.525

1280. ON EXCITED NEON ATOM CONCENTRATIONS IN A HOLLOW-CATHODE DISCHARGE.
I.P.Bogdanova and Chen-Gi-Tkhek.
Optika i Spektrosk., Vol. 2, No. 6, 681-8 (1957). In Russian.

Neon lines were photographed on a glass-prism spectrograph and the number of excited atoms in the levels was determined by intensity measurements on lines. A hollow cathode was used in which the discharge could be viewed through any of three holes in the cathode wall; the intenal depth of the cathode could be varied. The intensity of lines from the positive column in a double-cathode discharge tube was also measured; the length of the column could be easily varied. It was found that the group of levels $3s\,^3P_{2,1,0}$ (for pressures 0.5-1.1 mm Hg and currents 0.7-4.3 mA/cm^2) were more highly populated in the positive column than in the hollow cathode. The reverse was true for levels $3p\,^3P_0$, $3p\,^3D_3$ and $3s\,^1P_1$. Curves showing relationship between population and current are given. L.Bovey

539.18 : 539.2 : 548.736

1281. THE ELECTRONIC STRUCTURE OF THE METALS OF THE FIRST TRANSITION PERIOD. W.M.Lomer and W.Marshall.
Phil. Mag. (Eighth Ser.), Vol. 3, 185-203 (Feb., 1958).

Three distinct lines of experimental work now point towards a new conception of the electronic structure of the transition metals. Recent X-ray work has shown that in Fe and Cr the valence electrons are not as well localized near the atoms as had been supposed, while in Co, Ni and Cu the compact 3d-shell is nearly complete. Saturation magnetic moments of Ni-rich alloys show that Ti and V act as though they had respectively four and five electrons to contribute to the conduction band of Ni. Neutron diffraction evidence shows that pure Ti and V have no magnetic moments, ordered or disordered, and that in Ni–Cr alloys the Cr atom carries a moment not much different from Ni, though each added atom removes nearly 5 μ_B from the saturation moment. It is therefore suggested that elements of atomic number less than Fe have few 3d-electrons and many conduction electrons, while for those above iron this is reversed. It appears as though this conclusion can be maintained almost independently of crystal structure or composition of alloy. On this basis the variation of saturation magnetic moment of all the binary ferromagnetic alloys can be explained. A.

539.18

1282. VARIATIONAL CALCULATIONS OF DIPOLE POLARIZABILITIES OF HELIUM-LIKE IONS. E.G.Wikner and T.P.Das.
Phys. Rev., Vol. 107, No. 2, 497-501 (July 15, 1957).

The dipole polarizabilities of a number of helium-like ions are calculated by a variational procedure, using the analytic ground state wave-functions calculated for these ions by Green, Mulder, Lewis and Woll (Abstr. 4856/1954). The values agree well with those obtained by Sternheimer by a numerical solution of the first-order Schrödinger equation in the presence of an electric field. The basis for the convergence of the variational procedure is discussed along with its advantages and disadvantages relative to Sternheimer's procedure. Comparison is also made with experimental values of the polarizabilities. For helium, the value (0.218 A^3) is within 7% of the experimental value (0.204 A^3). For the ions Li^+, Be^{++}, B^{+++}, the agreement is only fair. The diamagnetic susceptibilities are also calculated in order to test the accuracy of the ground state wave-functions. The agreement of the values here with the experimental ones is very good. A.

539.18

1283. FINE STRUCTURE OF SINGLY IONIZED HELIUM.
E.Lipworth and R.Novick.
Phys. Rev., Vol. 108, No. 6, 1434-48 (Dec. 15, 1957).

The separation in energy (S) between the $2\,^2S_{1/2}$ and $2\,^2P_{1/2}$ states of singly ionized helium was measured to high precision by a microwave method. Helium atoms in a resonant cavity are excited to the $2\,^2S_{1/2}$ state of the ion by bombardment with 300 volt electrons. Radiofrequency power is applied to induce transitions between the two states and the 40.8 eV photon which arises from the decay of the $2\,^2P_{1/2}$ state to the $1\,^2S_{1/2}$ ground state of the ion is detected by a photomultiplier tube. A method of synchronous detection is employed to improve the signal-to-noise ratio. Twenty-six determinations of (S) were made under differing experimental conditions in an attempt to uncover sources of systematic error. The value of (S) obtained for He^+ is 14 040.2 ± 4.5 Mc/s. The uncertainty is equal to three times the standard deviation plus an estimated 1.5 Mc/s for the uncertainty in various systematic corrections. The result is in agreement with previous determinations but differs significantly from the best available theoretical value of 14 056.8 ± 3.0 Mc/s. It is shown that this discrepancy might be resolved, without impairing the excellent arrangement in hydrogen, by a theoretical relativistic term of the form $\alpha(AZ)^6 \ln(\alpha Z)$. A.

539.18

1284. THE DENSITY MATRIX AND THE FOUNDATIONS OF THE STATISTICAL THEORY. N.H.March.
Proc. Phys. Soc. A, Vol. 70, Pt 11, 839-41 (Nov., 1957).

The variational approach to the Thomas–Fermi model is reformulated using the density matrix. The success of this approach in a simple model suggests that it may resolve the boundary correction difficulties of the statistical theory. S.F.Edwards

539.18 : 537.525

EXCITED ATOMS IN NEON AND CADMIUM DISCHARGES. See Abstr. 1077

539.18 : 539.14

NUCLEAR FORCES AND THE STRUCTURE OF THE LITHIUM ISOTOPES. See Abstr. 1217

539.18

1285. MASS SPECTROSCOPIC ATOMIC MASS DIFFERENCES. II.
H.E.Duckworth.
Rev. mod. Phys., Vol. 29, No. 4, 767-72 (Oct., 1957).

For Pt I see Abstr. 2102 (1955). A brief description is given of the mass spectroscopic methods in current use for the determination of atomic masses. The agreement between atomic masses so-derived and those obtained by studying the energy balance in nuclear reactions is also touched upon, with particular reference to the mass of C^{12}. Finally, a table is given of the atomic mass differences which have been obtained mass spectroscopically during the past three years. A.

539.18

1286. ENRICHMENT OF THE URANIUM ISOTOPES IN A COUNTER-CURRENT GAS CENTRIFUGE.
W.Groth, E.Nann and K.H.Welge.
Z. Naturforsch., Vol. 12a, No. 1, 81 (Jan., 1957). In German.

The centrifuge consists of a hollow cylinder of length L = 63.5 cm and inner radius r = 6.7 cm rotating with a peripheral speed v = 250 m/sec. The gas is fed into the centre by a hollow shaft and removed in equal parts from the periphery at the top and from centre at the bottom by further hollow shafts. An axial temperature gradient is established by heating and cooling elements at the end faces. This causes a circulation which converts the usual radial separation $\exp(\Delta M\, v^2/2RT)$ into an axial separation, which raises, for the optimum temperature gradient, the elementary effect to the (L/2r)th power (ΔM is the difference in molecular weight of the two components). For $U^{235}F_6$–$U^{238}F_6$ the maximum ratio between top and bottom is, at the above running conditions, theoretically 1.185, experimentally 1.19. At a mean gas pressure of 19 mm Hg the equilibrium time was about 12 min. It is concluded that it is possible to pass 4.9×10^{-3} g/sec of UF_6 in which the isotope ratio of the light fraction differs from that of the heavy fraction by 20%.
H.London

539.18

1287. RADIATIVE CHARGE TRANSFER FROM H ATOMS TO He^{2+} IONS. A.M.Arthurs and J.Hyslop.
Proc. Phys. Soc. A, Vol. 70, Pt 12, 849-56 (Dec., 1957).

The rate coefficient for radiative charge transfer from H atoms to He^{2+} ions is calculated at temperatures in the range 250°K to 64 000°K. It is found to be almost independent of temperature and to be very high (the mean value being about 1.6×10^{-13} $cm^3.sec^{-1}$). As a subsidiary part of the work, earlier computations on the exact two centre wave-functions of the 1sσ and 2pσ states of HeH^{2+} and on the transition integral connecting these states are extended to internuclear separations up to 10 atomic units. A.

MOLECULES

539.19 : 537.562

1288. VIBRATIONAL STRUCTURE IN THE IONIZATION EFFICIENCY CURVES OF HYDROGEN AND DEUTERIUM MOLECULES. M.Krauss and A.Kropf.
J. chem. Phys., Vol. 26, No. 6, 1776-7 (June, 1957).

Mass spectrometer measurements of electron impact ionization of H_2 and D_2 showed that both molecule-ions were formed in the lowest vibrational state. Approximate calculations of probabilities of formation of higher vibrational states of the ions were made, showing significant differences between the ionization efficiency curves for H_2 and D_2, but confirming the large probability of the 0–0 transitions found experimentally. For polyatomic molecules, the most probable transition would probably be to a high vibrational state, and this might explain differences that have been observed between the ionization potentials of deuterated and undeuterated methanes and ammonias. J.Hawgood

539.19

1289. CALCULATION OF THE NORMAL VIBRATION FREQUENCIES AND OF THERMODYNAMIC FUNCTIONS OF GERMANIUM TETRAIODIDE.
I.N.Godnev, A.S.Sverdlin and N.I.Ushanova.
Optika i Spectrosk., Vol. 2, No. 6, 704-9 (1957). In Russian.

The normal vibration frequencies of GeI_4 molecules are calculated by extrapolation of the induction coefficients of the molecules GeF_4, $GeCl_4$ and $GeBr_4$. The mean values of the normal frequencies of GeI_4 were found to be: 171, 60, 276, and 87 cm^{-1}. This calculation method was checked by applying it to the normal frequencies of SiF_4. The calculated values of the SiF_4 normal frequencies were found to agree well with those obtained experimentally. Thermodynamic functions for GeI_4 were calculated assuming harmonic vibrations and a rigid rotator model. S.Chomet

539.19 : 535.333

ROTATIONAL BANDS OF BORON MONOFLUORIDE. See Abstr. 954

539.19 : 535.333

ROTATIONAL BANDS AND LEVELS OF ALUMINIUM HYDRIDE. See Abstr. 955

539.19 : 535.343

1290. SUBSTITUTED BENZENE SPECTRA.
L.Goodman and H.Shull.
J. chem. Phys., Vol. 27, No. 6, 1388-400 (Dec., 1957).

The low-lying π-electron excited states of substituted benzenes are examined from a semiempirical point of view, by using molecular orbital theory together with first-order configuration interaction as a basis. Different semiempirical parameters are introduced for the perturbations by a substituent upon states of different symmetry. Substituents exerting conjugative, inductive, and mixed effects are considered. Comparisons with experiment show that the experimentally observed facts concerning the effect of substitution upon the energy and intensity of these transitions are well accounted for by the theory. The relationship of the present treatment to that of the perimeter model introduced by Moffitt is discussed. The present model breaks down for very "strong" substituents when a higher-order configuration interaction treatment becomes essential. A.

539.19

1291. ELECTRONIC STRUCTURE OF DIBORANE. M.Yamazaki.
J. chem. Phys., Vol. 27, No. 6, 1401-4 (Dec., 1957).

The electronic structure of the ground state of diborane is discussed in terms of linear combinations of atomic orbitals—molecular orbitals from a basis consisting of the twelve-electron system with 1 s electrons on borons collapsed into the nucleus. Exact values for all one- and two-centre integrals are used, but approximations are made for many three- and four-centre integrals. The dissociation energy is calculated as 0.29 a.u. in poor agreement with the experimental value 0.816 a.u. The net charge on bridge hydrogen, on terminal hydrogen, and on boron is slightly negative, nearly neutral, and slightly positive, respectively. This is supported by experiments. For the central bonding linkage comparisons with other descriptions are made. A.

539.19

1292. CLASSICAL MOTION UNDER A MORSE POTENTIAL.
N.B.Slater.
Nature (London), Vol. 180, 1352-3 (Dec. 14, 1957).

The quantum energy levels, E_n, of diatomic molecules for energies less than the dissociation energy D, which were given by Morse, are closely related to those of the harmonic oscillator. There is a similar relation between classical motion in this potential field and simple harmonic motion. For $E < D$ the classical motion is periodic with frequency $\nu = \nu_0[(D-E)/D]^{1/2}$ which tends to zero as $E \to D$. For $E > D$ the classical motion is non-oscillatory, corresponding to dissociated states. Such a classical picture supplements the quantum-mechanical results. R.C.Seymour

539.19

1293. HIGH NEGATIVE NUCLEAR POLARIZATIONS IN A LIQUID. L.H.Bennett and H.C.Torrey.
Phys. Rev., Vol. 108, No. 2, 499-500 (Oct. 15, 1957).

In a field of 17.8 Oe the electron resonance signal of the naphthalene negative radical ion at 50 Mc/s and the proton resonance of the solvent, 1:2-dimethoxy-ethane at 6.8 kc/s can both be observed. Saturation of the electron resonance polarizes the solvent protons inversely to the field by an inverted Overhauser effect. Up to 65-fold enhancement of the proton resonance signal was then obtained, the degree of enhancement being proportional to the 50 Mc/s power. The relation between enhancement and saturating field agrees with theory assuming the protons to relax via their magnetic dipolar interaction with the "free" electron. There are possibilities that the process could be used as a stimulated emission amplifier.
D.H.Whiffen

539.19 : 535.343

1294. INFRARED STUDIES OF HYDROGEN BONDING OF METHANOL BY THE MATRIX ISOLATION TECHNIQUE.
M.Van Thiel, E.D.Becker and G.C.Pimentel.
J. chem. Phys., Vol. 27, No. 1, 95-9 (July, 1957).

The O–H stretching mode of hydrogen bonded methanol was studied by the matrix isolation technique using solid nitrogen at 20°K as a matrix. The bands are narrow and permit assignment of absorptions at 3660, 3490, 3445, 3290, and 3250 cm^{-1} to the species, respectively, monomer, dimer, trimer, tetramer, and higher polymers. The results correlate with the room temperature concentration dependence of the H bonded O–H stretching mode of methanol in solution. The dependence of frequency upon polymer size suggests that methanol dimers and trimers have cyclic structures and higher

polymers have open (chain) structures. In the cyclic structures, the strain associated with the bent H bond is assumed to account for the low-frequency shift of dimers and trimers compared to higher polymers. A.

539.19 : 535.343

1295. INFRARED STUDIES OF HYDROGEN BONDING OF WATER BY THE MATRIX ISOLATION TECHNIQUE.
M.Van Thiel, E.D.Becker and G.C.Pimentel.
J. chem. Phys., Vol. 27, No. 2, 486-90 (Aug., 1957).

The stretching and bending vibrational modes of the hydrogen bonded polymers of water were studied by the matrix isolation technique using solid nitrogen at 20°K as a matrix. Absorptions are assigned to water monomers (2725, 3627, and 1600 cm^{-1}), to dimers (3691, 3546, and 1620 cm^{-1}) and to higher polymers (3510, 3355, 3318, 3222, and 1633 cm^{-1}). The frequencies suggest that the dimers have cyclic rather than open (or bifurcated) structures. The absorption coefficients of the bending modes decrease slightly in the higher polymers whole those of the stretching mode increase by a factor of about twelve. This intensity behaviour cannot be explained solely on the basis of enhanced ionic character of the O—H group in the hydrogen bond. A.

539.19 : 541.57

1296. RECIPROCAL MEAN AS A MEASURE OF COVALENT BOND ENERGY. T.T.L.Allen.
J. chem. Phys., Vol. 27, No. 3, 810-11 (Sept., 1957).

In calculating the energy of a hypothetical covalent bond between unlike atoms A—B, it is usual to use either a geometric or an arithmetic mean of values from bonds A—A and B—B. It is now suggested that a reciprocal mean may be better; this appears to be so for potassium hydride and gives a better value of the ionic resonance energy. A.G.Gaydon

539.19 : 548.736.3

MOLECULAR STRUCTURE OF DIBORON TETRAFLUORIDE, B_2F_4. See Abstr. 832

539.19

1297. USE OF GAUSSIAN FUNCTIONS FOR INTERMOLECULAR POTENTIALS. K.Singer.
Nature (London), Vol. 181, 262-3 (Jan. 25, 1958).

The superposition of two Gaussian potentials with suitably chosen constants provides a good approximation to a Lennard-Jones intermolecular potential and simplifies calculations. Closed forms are obtained for the average potential energies of three statistical models, each consisting of an assembly of particles for which the probability density in configuration space is expressible in terms of Gaussian functions and their derivatives. M.J.Kearsley

539.19

1298. THERMODYNAMICS OF THE V—O SYSTEM: DISSOCIATION ENERGIES OF VO AND VO_2.
J.Berkowitz, W.A.Chupka and M.G.Inghram.
J. chem. Phys., Vol. 27, No. 1, 87-90 (July, 1957).

The molecules vaporizing from V_2O_5(s) and VO(s) were determined employing a mass spectrometer to analyse the vapours effusing from Knudsen cells containing these materials. The vapour over the V_2O_5 loaded cells was found to contain V_4O_{10}(g), V_6O_{14}(g), V_6O_{12}(g) with some evidence for V_4O_8(g) and V_2O_4(g). Since both the composition and the partial pressures varied with time no quantitative data could be obtained for these molecules. By contrast, both the composition and partial pressures of the vapour over VO(s) were essentially constant with time. The molecules observed were V(g), VO(g), and VO_2(g). A thermodynamic treatment of the data yields 6.4 ± 0.2 eV and 12.8 ± 0.2 eV, respectively, for the atomization energies of VO and VO_2. A.

539.19

1299. THERMODYNAMICS OF THE Ta—O SYSTEM: THE DISSOCIATION ENERGIES OF TaO AND TaO_2.
M.G.Inghram, W.A.Chupka and J.Berkowitz.
J. chem. Phys., Vol. 27, No. 2, 569-71 (Aug,, 1957).

Mass spectrometric analysis of the vapour in thermodynamic equilibrium with mixtures of Ta(s) and Ta_2O_5(s) showed TaO and TaO_2 to be the predominant gaseous molecules present. The experimental data yield 8.4 ± 0.5 eV and 15.0 ± 0.5 eV for the energies of atomization of these molecules at 0°K. A.

539.19

1300. TECHNIQUE TO PRODUCE FREE RADICALS IN THE SOLID STATE. H.A.Papazian.
J. chem. Phys., Vol. 27, No. 3, 813-14 (Sept., 1957).

Colour is produced in CH_3I, CH_3OH, $(CH_3)_2NH$ and NH_3 condensed at liquid nitrogen temperatures, by an electric discharge. The colour is bleached by warming, suggesting that it is due to free radicals. J.E.Caffyn

539.19 : 534.23.08

RELAXATIONAL CONTRIBUTION TO ACOUSTIC ABSORPTION BY CYCLOPROPANE MOLECULES. See Abstr. 923

539.19 : 537.525

THE DECAY AND NATURE OF ACTIVE NITROGEN. See Abstr. 1078-9

SOLID-STATE PHYSICS

539.2 : 539.31

1301. THE ELASTICITY OF THE CRYSTALLINE MEDIUM. I. THE POTENTIAL ENERGY OF A CRYSTAL AND THE INTERATOMIC FORCE CONSTANTS. J.Laval.
J. Phys. Radium, Vol. 18, No. 4, 247-59 (April, 1957). In French.

Formal theoretical treatment of the effect on the symmetrical tensor of interatomic force constants of thermal expansion, of triatomic and higher interaction terms, of non-central forces, and of coherent displacements of the lattice. A fundamental relation between the force constants is obtained, and reasoning due to Born (1915) leading to an analogous relation is criticized, it being shown that the latter is necessarily true only for lattices of high symmetry with central forces. J.Hawgood

539.2 : 539.31

1302. THE ELASTICITY OF THE CRYSTALLINE MEDIUM. II. DYNAMICS OF ELASTIC WAVES. J.Laval.
J. Phys. Radium, Vol. 18, No. 5, 289-96 (May, 1957). In French.

In an unbounded crystalline medium the oscillations performed by the atoms form plane waves (elastic waves). The frequency and the shape of the oscillations are determined by the latent roots and by the latent vectors of a matrix, the so-called Fourier matrix. The atomic oscillations which occur in a crystal (a bounded medium) likewise form plane waves, as shown by experimental studies (Raman effect, X-ray scattering). This is because the elastic force exerted on each atom has a very small effective radius of action. Therefore, the oscillations defined by the Fourier matrix also conform to those which occur in crystals. Particularly one can deduce from the Fourier matrix an "atomic" matrix which concerns the acoustic oscillations of low frequency, considered by classic elasticity. This atomic matrix determines the velocity of the waves and the direction of the displacements. The dynamic elastic constants included in this matrix are not identical to the Voigt elastic constants; they assume 36 distinct values instead of 21 for a triclinic crystal. The classical theory agrees with a field of central forces. It implies oscillations which repeat by symmetry operations not belonging to the crystalline medium. This conclusion is inconsistent with experiment. A.

539.2 : 539.31

1303. THE ELASTICITY OF THE CRYSTALLINE MEDIUM. III. LINEAR DEFORMATIONS (STATIC ELASTICITY). J.Laval.
J. Phys. Radium, Vol. 18, No. 6, 369-79 (June, 1957). In French.

Linear (or homogeneous) deformations are those which preserve the periodicity of the crystalline medium. They arise from static elastic constants which are different from the Voigt elastic constants, having 45 distinct values for a triclinic crystal. When related to a reference system bound to the free crystalline medium, linear deformations are generally rotational. The crystalline medium is in equilibrium under the applied stresses when the deformation energy is stationary with reference to rotations. Moreover, the static elastic constants and the dynamical elastic constants (specific to elastic waves) have not the same tensor symmetry; they form two distinct series. This difference occurs however high the symmetry of the crystalline medium may be. It is due to the fact that the cohesive forces between the atoms are not central forces. A.

539.2

1304. THEORY AND PROPERTIES OF SOLID ARGON.
E.R.Dobbs and G.O.Jones.
Rep. Progr. Phys., Vol. 20, 516-64 (1957).

In the last few years measurements have been made of the thermodynamic properties of solid argon which provide ideal material for the verification of the theory of crystal lattices. Starting from the basic problem of the crystal lattice, a review is given here of the dynamics and thermodynamics of the inert gas crystals. Satisfactory agreement is obtained in many cases between

theory and experiment when the calculations are based on an anharmonic Einstein theory with a (12,6) interatomic potential. It is shown that further progress requires, in particular, the extension of experiments to lower temperatures and of theoretical calculations of the repulsion of argon atoms to a higher approximation. A.

539.2

1305. LATTICE DYNAMICS OF HEXAGONAL CLOSE-PACKED METALS. II. FREQUENCY SPECTRUM.
C.W.Garland and L.J.Slutsky.
J. chem. Phys., Vol. 28, No. 2, 331-4 (Feb., 1958).

For previous part see Abstr. 5721 (1957). The frequency distribution spectrum of the normal modes of vibration for a hexagonal close-packed metal is approximated by a root sampling technique applied to a central force model of the lattice. The calculation is made for magnesium with force constants obtained from the low temperature elastic constants. The calculated specific heat of magnesium from 0°K to 100°K is in quite good agreement with experiment. Other hexagonal metals are considered in terms of a reduced plot of θ (the equivalent Debye temperature) v. temperature. A.

539.2

1306. THE USE OF A MODEL IN ANHARMONIC LATTICE DYNAMICS. D.J.Hooton.
Phil. Mag. (Eighth Ser.), Vol. 3, 49-54 (Jan., 1958).

Skyrme (Abstr. 5887/1957) discussed the use of a model in quantum mechanics. His method is applied to the case of the anharmonic vibrations of a crystal lattice, and compared with a previous treatment by the present author. Some remarks are added which give a new and more physical interpretation of the results of this earlier work. A.

539.2

1307. LATTICE VIBRATIONS AND HARMONIC FORCES IN SOLIDS. A.J.E.Foreman and W.M.Lomer.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1143-50 (Dec., 1957).

A discussion is given of the interpretation in terms of harmonic forces between atoms of the phonon frequency against wave-vector data which is provided by the results of both X-ray and neutron scattering experiments. A knowledge of the phonon polarization vectors is required before a calculation of the components of the interatomic harmonic force tensors between all neighbour atom pairs can be made, but for lattice waves propagating along the symmetry directions of a crystal the Fourier series expansions of the dispersion curves give directly the harmonic force constants between entire planes of atoms. The interpretation of these interplanar force constants in terms of a model with interatomic tensor harmonic forces between a limited number of atom neighbours may require that the interplanar force constants satisfy an internal consistency relation; the failure of the X-ray data for aluminium to satisfy this relation exactly suggests either that atoms beyond the fourth nearest neighbour are interacting appreciably or that the concept of static harmonic forces between atoms is breaking down. A.

539.2

1308. THE THEORY OF PLASMA OSCILLATIONS IN METALS. S.Raimes.
Rep. Progr. Phys., Vol. 20, 1-37 (1957).

Plasma oscillations in gas discharges have been known and studied for nearly thirty years. The existence of similar oscillations in metals, i.e. longitudinal oscillations of the valence electron gas, analogous to sound waves, was suggested over twenty years ago, but only recently has their full significance been realized. The Coulomb interaction of the electrons in a metal can be divided into two parts: a long-range part, whose effect is described by the plasma oscillations; and a residual "screened" interaction, whose range is about 1 A. Owing to the large excitation energy of a plasma oscillation, the long-range part can be ignored in many calculations, which explains the success of the independent particle model on which the band theory of metals is based. In the first half of this article, after a critical discussion of previous treatments of the Coulomb interaction, the elements of the plasma theory are made plausible by simple arguments. Then the quantum-mechanical theory of plasma oscillations in a free-electron gas, due to Bohm and Pines, is described, including an account of the calculation of the correlation energy. Experimental evidence of the existence of plasma oscillations, afforded by the energy losses of fast electrons in penetrating thin metallic films, is then discussed. Finally, going beyond the free-electron approximation, a semi-quantitative theory of the effects of the periodic lattice field and of the core electrons is given. A.

539.2

1309. ON THE DETERMINATION OF THE EFFECTS OF INTERACTION TERMS FOR POLAR AND NON-POLAR SOLIDS. A.Haug.
Z. Phys., Vol. 148, No. 4, 504-7 (1957). In German.

The method of treating electron–lattice interactions described in Abstr. 570 (1957) is extended for both non-polar and polar solids. C.A.Hogarth

539.2

1310. THE BAND STRUCTURE OF THE TRANSITION METALS. N.F.Mott and K.W.H.Stevens.
Phil. Mag. (Eighth Ser.), Vol. 2, 1364-86 (Nov., 1957).

A discussion is given, based on the available results of experiment and of calculation, of the band structures of certain transition metals and of their relationship to their electrical and magnetic properties. A.

539.2

1311. MULTIPLE ECHOES IN SOLIDS. I.Solomon.
C.R. Acad. Sci. (Paris), Vol. 245, No. 12, 1011-16 (Sept. 16, 1957). In French.

The method of spin echoes was applied to the study of the quadrupole splitting of nuclear levels by an electric field gradient. For iodine in a KI crystal a suitable pulse sequence produces five echoes, in agreement with the theory which is briefly reported. D.J.Oliver

539.2

1312. ELECTRON SPIN RESONANCE OF COALS: SATURATION EFFECT. J.Smidt.
Nature (London), Vol. 181, 176 (Jan. 18, 1958).

Results are given for the power P required to produce a value of 0.5 for the saturation factor as a function of carbon concentration. Up to 88% of C P is less than about 0.5 mW/g, but thereafter increases rapidly to nearly 100 mW/g at 94% of C, the limit of measurement. These values are important in determinations of the number of free radicals. Experiments with samples of high ash content suggest the presence of paramagnetic impurities. D.J.Oliver

539.2

1313. DONOR ELECTRON SPIN RELAXATION IN SILICON. E.Abrahams.
Phys. Rev., Vol. 107, No. 2, 491-6 (July 15, 1957).

A study of donor electron spin relaxation which can occur due to the presence of spin–orbit coupling is carried out. It is found that at helium temperatures both the direct and Raman processes are too weak to be observed, but that at 14°K the Raman process yields a relaxation time of 1 sec. Several mechanisms of relaxation due to the interaction with conduction electrons are also discussed. It is found that none of them can compete with the exchange-scattering process considered by Pines, Bardeen, and Slichter (Abstr. 5727/1957). A.

539.2

1314. NEW V-CENTER SPIN RESONANCE IN LiF.
M.H.Cohen, W.Känzig and T.O.Woodruff.
Phys. Rev., Vol. 108, No. 4, 1096-7 (Nov. 15, 1957).

By warming LiF crystals after X-irradiation at or below 77°K the defect centres produced (F_2^- molecular ions) disappear and new centres are produced. One of these is identified by spin resonance as a F_3^{--} centre. Results with different orientations of the d.c. magnetic field suggest that the vacancy configuration is that of the V_4 centre in the alkali halides. Some detailed analysis of the hyperfine structure of the resonance spectrum is given. G.F.J.Garlick

539.2 : 538.114

1315. MICROWAVE RESONANCE IN NICKEL AT 35 Gc/s (kMc/s). G.S.Barlow and K.J.Standley.
Proc. Phys. Soc., Vol. 71, Pt 1, 45-8 (Jan., 1958).

From microwave resonance measurements at 35 Gc/s (λ = = 0.86 cm) on a nickel single crystal, the anisotropy constants K_1 and K_2 have been determined from 20 to 150°C. At 20°C, $K_1 = K_2 = -6.06 \times 10^4$ erg/cm^3 gives the best fit with the experimental data. The g-values of 2.19 ± 0.02 were obtained for the nickel single crystal and for polycrystalline nickel and nickel–copper alloys containing up to 26 atomic per cent of copper. For nickel–manganese alloys, a decrease in g-value with increase in manganese content occurred, reaching 2.12 for the 13.5 atomic per cent manganese alloy. A.

539.2

1316. MICROWAVE PROPERTIES OF SOLIDS.
D.M.S.Bagguley and J.Owen.
Rep. Progr. Phys., Vol. 20, 304-78 (1957).

This report discusses the application of electron magnetic resonance techniques to defect and impurity sites in solids, conduction electrons in metals, ferromagnetic, ferrimagnetic and antiferromagnetic materials. It also reviews the recent experiments on cyclotron resonance in semiconductors together with a brief account of some experiments involving the non-resonant absorption of microwaves by conductors at low temperatures and by ferrites. A.

539.2

1317. THE INTERACTION BETWEEN EQUILIBRIUM DEFECTS IN THE ALKALI HALIDES: THE "GROUND STATE" BINDING ENERGY OF THE VACANCY PAIR. M.P.Tosi and F.G.Fumi.
Nuovo Cimento, Vol. 7, No. 1, 95-106 (Jan. 1, 1958).

The Born—Mayer model of ionic solids is used to calculate the binding energy of a positive-ion vacancy and a negative-ion vacancy at the distance of nearest neighbours in NaCl and KCl crystals: the results are 0.6 eV and 0.7 eV respectively. This leads one to expect in NaCl an equilibrium concentration of vacancy pairs ranging from 10% to 20% of the equilibrium concentration of Schottky defects between 500°C and 700°C. The available experimental data are compatible with the existence in the alkali halide crystals of an equilibrium concentration of vacancy pairs of this order of magnitude in the intrinsic temperature region. A.

539.2

1318. THE CENTRE OF A DISLOCATION. I. E.H.Yoffe.
Phil. Mag. (Eighth Ser.), Vol. 2, 1197-210 (Oct., 1957).

An attempt is made to describe mathematically the state of stress at the centre of an edge dislocation. The discontinuity in stress across the slip plane suggests the use of the more general type of dislocation previously investigated by the author. As shown in the earlier paper the more general dislocation may be built up from an array of simple edge dislocations. Here the converse is applied; the simple edge dislocation is presented as the difference of two or more dislocations of the more general type. By this means it is possible to eliminate the central singularity hitherto obtained in the elastic dislocation, to calculate the stresses at all points, and to plot the law of force acting across the slip plane. The method is believed to be new, and is found capable of wider application. A.

539.2

1319. THE CENTRE OF A DISLOCATION. II. THE DILATED SLIT. E.H.Yoffe.
Phil. Mag. (Eighth Ser.), Vol. 3, 8-18 (Jan., 1958).

Describes investigations of the elastic field near the centre of an edge dislocation and is concerned with the local expansion due to atomic misfit, causing a singularity similar to a particular type of centre of pressure. The corresponding stress field is added to that of Pt I to give the complete elastic field of a dislocation in a crystal. The solution is also applicable to the dilation of a slit by a solid inclusion, and therefore gives an indication of the stress field of a tapered precipitate in a crystal matrix. A.

539.2

1320. ELECTROSTATIC FIELDS ROUND LOCALIZED DEFECTS IN METALS. P.M.Lee and N.H.March.
Phil. Mag. (Eighth Ser.), Vol. 2, 1226-36 (Oct., 1957).

A procedure for dealing with localized defects in metals is proposed, based on three main assumptions. First, the validity of the Thomas—Fermi approximation is assumed, secondly departures of the perturbing potentials from spherical symmetry are neglected, and thirdly, no account is taken of any relaxation of the lattice which may occur on the introduction of localized defects. However, the framework outlined is sufficiently general to enable the second assumption to be avoided, should this turn out to be necessary. It is expected that the method will be useful for foreign atoms entering the lattice substitutionally, provided the atomic size is such that no serious distortion of the lattice is produced, and also for vacancies, although in this latter case it will no doubt eventually prove necessary to consider relaxation effects. The method proposed is illustrated by studying numerically the case of a vacancy in copper, and an approximate self-consistent field is established for the perturbed lattice, based on the method of Slater and Krutter for the unperturbed crystal. A partial wave-analysis using the free-electron approximation is then carried out. The resistivity comes out considerably larger than that obtained by previous workers and possible reasons for this are discussed. A.

539.2

1321. OBSERVATIONS ON HELICAL DISLOCATIONS IN CRYSTALS OF SILVER CHLORIDE. D.A.Jones and J.W.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 3, 1-7 (Jan., 1958).

Prismatic and concentric helical prismatic dislocations are generated by the stress field which appears around a spherical glass inclusion in a silver chloride crystal when the crystal is cooled from a temperature of 370°C to room temperature. The properties of these dislocations are described and their origin is discussed. A.

539.2

1322. CHARGED DISLOCATIONS AND THE STRENGTH OF IONIC CRYSTALS.
J.D.Eshelby, C.W.A.Newey, P.L.Pratt and A.B.Lidiard.
Phil. Mag. (Eighth Ser.), Vol. 3, 75-89 (Jan., 1958).

If the energies required to form positive and negative ion vacancies in an ionic crystal are unequal, then in thermal equilibrium dislocations in the crystal will be electrically charged and surrounded by a Debye—Hückel cloud of vacancies. If the vacancy cloud is immobile a finite force is required to separate the dislocation from the cloud, and so the crystal will possess a yield stress below which plastic flow will not occur. The presence of divalent impurities modifies the magnitude of the charge on a dislocation, and may even reverse it. If precipitation of the impurity or association of impurity atoms and vacancies can occur, the concentration of impurities may be a complicated function of temperature. The yield stress of the crystal may then exhibit maxima and minima when plotted as a function of temperature. Experimental results showing this behaviour are presented and tentatively compared with the theory. A.

539.2

1323. THE OBSERVATION OF VACANCY SOURCES IN METALS.
R.S.Barnes, G.B.Redding and A.H.Cottrell.
Phil. Mag. (Eighth Ser.), Vol. 3, 97-9 (Jan., 1958).

Helium atoms were injected into copper by alpha-particle bombardment in a cyclotron. On subsequent heating, the helium precipitates out as small gas bubbles in those parts of the metal where the helium atoms receive vacancies from nearby sources. From the distribution of the gas bubbles it is concluded that grain boundaries are effective sources of vacancies, but twin boundaries are not. Isolated sources of sources of vacancies exist within the crystals, but there is no evidence that the dislocation network generates appreciable numbers of vacancies. A.

539.2 : 539.374

1324. ON THE ORIGIN OF DISLOCATIONS.
D.Kuhlmann-Wilsdorf.
Phil. Mag. (Eighth Ser.), Vol. 3, 125-39 (Feb., 1958).

In the face-centred cubic lattice a stacking fault, caused by the condensation of vacancies on a {111} plane, is converted into a dislocation source of Frank—Read type if it is swept by a half-dislocation of a kind that restores lattice order. Dislocation sources will also arise in other major lattice types through the condensation of vacancies on close-packed lattice planes. It is proposed that these are the dislocation sources which release a major proportion, if not all, of the dislocations formed during plastic deformation. Besides several minor advantages, the introduction of this kind of dislocation source can account for all the important glide systems found in crystals of the most common lattice types. A.

539.2 : 539.377

1325. GENERATION OF IMPERFECTIONS IN GERMANIUM CRYSTALS BY THERMAL STRAIN. P.Penning.
Philips Res. Rep., Vol. 13, No. 1, 79-97 (Feb., 1958).

Thermal strain is induced in a crystal if it is heated inhomogeneously. These strains can be so large that either plastic flow or cracking may take place. Both effects have been observed in crystals quenched from high temperature. In the case of plastic flow the distribution of dislocations, as revealed by etching, shows marked characteristics, dependent on the way of quenching and the orientation of the crystal. It is shown that these characteristics can be explained very well if it is assumed that the amount of plastic flow is directly proportional to the elastic strain induced by the non-uniform temperature. During the growth of a crystal from a melt, thermal strain may also very well be present in the crystal. The main sources of these strains are indicated and their influence on the perfection of the growing crystal are discussed. Secondary effects of plastic flow due to thermal strain in grown crystals and quenched samples, such as residual stresses and the freezing in of defects, are discussed briefly. A.

539.2

1326. DISTORTION OF THE LATTICE AROUND AN INTERSTITIAL, A CROWDION, AND A VACANCY IN COPPER.
L.Tewordt.
Phys. Rev., Vol. 109, No. 1, 61-9 (Jan. 1, 1958).

A general method for calculating lattice distortion around point defects is proposed. Atoms in a sufficiently large region I around the defect and in a "boundary" region II around region I are treated as discrete particles. A set of proper elastic solutions is joined to the displacements of the atoms in region II. The equilibrium state of the lattice is determined by successive solution of sets of linear algebraic equations. Actual calculations are done with the help of the Illiac digital computer for an interstitial, a crowdion, and a vacancy in copper. The changes in volume of the crystal arising from these defects are found to be 1.7, 1.1, −0.53 and 2.0, 1.3, −0.45 atomic volumes respectively for the two Born—Mayer repulsive potentials used. In addition to the distortion of the lattice around an isolated defect, the distortion around an interstitial-vacancy pair is treated. The electronic contributions to the formation energies of the defects considered are estimated in a way similar to that used by Fumi in the case of a vacancy. However, the change in the effective charge of the defect with lattice dilatation is also taken into account. The formation energy of a crowdion is found to be about 0.6 eV higher than that of an interstitial. The calculated values of the change in volume are discussed in connection with experimental results on radiation damage in copper. A.

539.2

1327. STACKING FAULTS AND DISLOCATIONS IN COPPER—ALUMINIUM AND COBALT—NICKEL ALLOYS.
J.W.Christian and J.Spreadborough.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1151-61 (Dec., 1957).

Stacking fault densities α' in heavily cold-worked powders of copper—aluminium and cobalt—nickel alloys were measured from the peak shifts, using Paterson's theory. The Fourier coefficients of the broadening function due to faults are calculated for the {111} and {200} powder lines, assuming equal densities of faults on all {111} planes, and these enable the strain broadening function to be evaluated from the measured coefficients. This function has approximately a Cauchy shape. Dislocation densities ρ estimated from the strain breadth ξ and mean square strain $\langle S^2 \rangle$, very much less with composition than does α'. Faults and dislocations disappear together on annealing, so that there is a linear relation between ρ and α'. It is nevertheless suggested that the stacking fault diffraction effects cannot be attributed to the fault ribbons in extended dislocations, as previously stated. A.

539.2

1328. COLORATION OF $BaTiO_3$ CRYSTALS.
M.S.Kosman and E.V.Bursian.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 3, 483-5 (1957). In Russian.

The darkening of $BaTiO_3$ polycrystals under certain influences is mainly due to reduction and liberation of the metal (therefore accompanied by changes of electrical characteristics), whereas colour changes in monocrystals are due to a purely physical process, similar to the electric field effects in alkali-halide crystals ("additive" coloration). Reversible colour changes are produced by annealing (brown—yellow) and others by electric fields (red, brown, partly blue). Interesting effects are produced by alternating fields.
Electrical Research Association

539.2

1329. REMARKS ON HACSKAYLO'S PAPERS. V.F.Pisarenko.
Optika i Spektrosk., Vol. 2, No. 4, 538-9 (1957). In Russian.

See Hacskaylo et al., Abstr. 8562/1952, 3727/1953, 872/1954, 9240/1955. The author found that bands analogous to W_1 and W_2 are observed on electrolytic colouring not only of NaCl, but also of KCl, KBr and KI crystals, these bands being identical with the V-bands. The following explanation of the phenomena involved is proposed. U-centres formed during electrolytic colouring and subsequent discoloration are transformed into stable F-centres when irradiated with X-rays or ultraviolet rays. The presence of U-centres in crystals determines the alkaline reaction of their solutions. Partial destruction of W-bands when F-centres are formed by irradiation is explained by the recombination of the electrons released from U-centres with F-centre holes. A mechanism is suggested for the process of crystal coloration. F.Lachman

539.2 : 535.399

1330. THE INFLUENCE OF POLARIZED LIGHT ON COLOUR CENTRES IN ALKALI HALIDE CRYSTALS. O.A.Shmit.
Optika i Spektrosk., Vol. 2, No. 6, 755-8 (1957). In Russian.

On illuminating coloured single crystals of KCl with linearly polarized light of wavelength corresponding to the F-absorption band new absorption bands are formed which possess dichroism. The appearance of dichroism on the absorption of light is also observed in the F-band. A hypothesis is advanced that the observed dichroism in the M-band is linked with the intrinsic structure of the M-centres, and in the F-band — with the polarizing action of M_2-centres on F-centres. By using polarized light it appears possible to resolve the question of repeated trapping. C.H.L.Goodman

539.2

1331. ELECTRONIC g-FACTOR AND THE STRUCTURE OF F-CENTERS. F.J.Adrian.
Phys. Rev., Vol. 107, No. 2, 488-90 (July 15, 1957).

A study is made of the small electronic g-factor shifts observed in complex paramagnetic substances. In most cases there is a simple connection between the contribution of a given ion or atom to Δg and the anisotropic part of the magnetic hyperfine interaction of its nucleus with the electron. This connection is useful now that a double-spin-resonance technique developed by Feher can give experimental values for such hyperfine interaction constants. The theory is applied to the case of the F-centre. It is shown that a central F-centre wave-function need not have a large g-state component to account for the order of magnitude of the observed Δg, provided that the function used is orthogonal to the ion-core orbitals. Both the positive and negative ions contribute to Δg. With the aid of Feher's hyperfine-structure measurements in KCl, one gets: Δg (theory) = −0.0053 as compared with Δg (exp) = −0.0070. Exchange interactions between the F-electron and the ion-core electrons are offered as a possible explanation of the positive Δg found for LiF. Such interactions could polarize the nearest-neighbour halide ions, effectively creating a hole. It is estimated that a 0.5-1% polarization of the F^- 2p orbitals would be required. A.

539.2 : 539.14

NUCLEAR MAGNETIC RESONANCE IN NITRIC AND PERCHLORIC ACID CRYSTALS. See Abstr. 720

539.2 : 537.521

EQUILIBRIUM PROPERTIES OF A CLASSICAL PLASMA. See Abstr. 1074

539.21

1332. THE HARDENING AND EMBRITTLEMENT OF STEEL BY IRRADIATION WITH NEUTRONS.
A.T.Churchman, I.Mogford and A.H.Cottrell.
Phil. Mag. (Eighth Ser.), Vol. 2, 1271-5 (Oct., 1957).

The tensile yield and fracture strengths of a structural steel were measured before and after irradiation with neutrons. The fracture strength increases with irradiation at the same rate as the yield strength and the embrittlement cannot be ascribed to a loss of cohesive strength. Measurements were made of the effects of grain size and testing temperature on the yield and fracture strengths; applied to Petch's equation they show that the radiation hardening is caused essentially by an increase in "frictional" resistance in the slip planes, such as would be produced by dispersed islands of radiation damage, and that the cohesive strength of the lattice and the dislocation locking stress are not detectably changed by the irradiation. Notched-impact tests were also made to show the embrittling effect of the irradiation. A.

539.21 : 539.12

DISPLACEMENT OF Cu ATOMS BY ALPHA-IRRADIATION. See Abstr. 1156

STRUCTURE OF SOLIDS

539.213.2 : 535.345 : 537.311.33

VITREOUS SEMICONDUCTORS. See Abstr. 1048

539.215 : 539.89 : 537.323 : 537.312.9

CONTACT EFFECTS RESULTING FROM COMPRESSION AND FLASH SINTERING IN GRAPHITE POWDERS. See Abstr. 623

539.216 : 539.42

1333. HIGH-TEMPERATURE TENSOMETRY AND ITS APPLICATION TO AMORPHOUS POLYETHYLENE TEREPHTHALATE.
E.L.Foster and H.Heap.
Brit. J. appl. Phys., Vol. 8, No. 10, 400-2 (Oct., 1957).

Amorphous polyethylene terephthalate will crystallize at elevated temperatures either by the action of the temperature alone or as a result of a stretching process. An apparatus has been constructed by means of which the stress-strain curves of amorphous

polyethylene terephthalate in the rubber-like state may be investigated under conditions where the material is heated for a period of not more than one second before the application of the strain. In this way spontaneous crystallization is minimized and the crystallization due to stretching may be studied. The effects of both temperature and straining rate on the shape of the stress–strain curve were investigated and the results indicate that the crystallization is stress-controlled. The application of the results to the fibre spinning and drawing processes is discussed. A.

539.217

1334. MEASUREMENT OF THE DIFFUSION RATE OF HYDROGEN IN NICKEL. A.G.Edwards.
Brit. J. appl. Phys., Vol. 8, No. 10, 406-9 (Oct., 1957).

The diffusion rate of hydrogen within nickel was measured by making observations on the rate of escape of the gas from a hydrogen-soaked nickel wire heated in vacuo. The value obtained agrees, within experimental error, with data on solubility and permeation rate through foils interpreted on the assumption that energy barriers to gas penetration through surfaces are small. A.

539.217

1335. PREFERENTIAL DIFFUSION OF Sb ALONG SMALL ANGLE BOUNDARIES IN Ge AND THE DEPENDENCE OF THIS EFFECT ON THE DIRECTION OF THE DISLOCATION-LINES IN THE BOUNDARY. F.Karstensen.
J. Electronics and Control, Vol. 3, No. 3, 305-7 (Sept., 1957).

The diffusion of Sb in bicrystals of Ge (tilt boundaries of 10^0 on a common ⟨100⟩ axis) has been studied by following the migration of the p–n junction. An enhanced diffusion rate in the boundary was observed parallel to the directions of the dislocations but no increase was found in the direction perpendicular to their Burger's vectors. A.B.Lidiard

539.217

1336. DIFFUSION OF MERCURY IN AMORPHOUS SELENIUM. S.Steeb, K.H.Jürgensen and S.Magun.
Z. Elektrochem., Vol. 61, No. 6, 763-7 (1957). In German.

Amorphous selenium layers of 1 μ thickness were exposed to mercury vapour in high vacuum and the change of electrical resistance with time measured. Results indicate that amorphous selenium is a defect electron conductor, and that the diffusion coefficient for mercury diffusing in selenium is $0.17\text{-}2.8 \times \times 10^{-9}$ cm^2/min. Hall effect and X-ray analysis measurements were also carried out. The concentration of mercury in the layer was determined using radioactive mercury. It is deduced that each mercury atom in the layer releases one electron for charge transport. B.T.M.Willis

539.219

1337. LIQUID⇌SOLID EQUILIBRIUM IN COPPER AND SILVER ALLOYS; WITH AN APPENDIX ON THE EQUILIBRIUM DIAGRAM OF THE SYSTEM COPPER-ARSENIC.
W.Hume-Rothery and J.Burns.
Phil. Mag. (Eighth Ser.), Vol. 2, 1177-96 (Oct., 1957).

The liquidus and solidus curves for the α-solutions, of Cd, In, Sn, and Sb in Ag, and of Zn, Ga, Ge, and As, in Cu are discussed. In the Ag-series a given depression of the solidus is produced by atomic percentages of Cd, In, Sn, and Sb proportional to $1/2^2 : 1/3^2 : : 1/4^2 : 1/6^2$, and in the Cu-series by amounts of Zn and Ga proportional to $1/3^2 : 1/4^2$. The increases in mean lattice spacing produced by a given atomic percentage of Cd, In, Sn, and Sb dissolved in Ag are as 2 : 3 : 4 : 6, and by a given atomic percentage of Zn and Ga dissolved in Cu are as 3 : 4. The solidus curves and lattice distortions thus involve the same whole number sequences, but this correspondence breaks down in the system Cu–As where the electrochemical factor is high, and the same effect to a lesser degree is apparent in the system Cu–Ge. In the systems Ag–Cd, Ag–In, Ag–Sn, Cu–Zn, Cu–Ga, and Cu–Ge the liquidus and solidus curves in dilute solutions are connected by a relation of the type $x_l = k\sqrt{x_s}$ where x_l and x_s are the atomic percentages of solute in the liquid and solid phases. In this class of alloy the liquidus and solidus curves depend primarily upon electron concentration, modified by lattice distortion, and diagrams are given showing these effects. Increasing electrochemical factor (e.g. Cu–As, Ag–Mg) produces an additional steeper fall in the liquidus and solidus. The equations of H.Jones are used to calculate the effects of solute elements on the latent heat of fusion of Ag and Cu, and the way in which these are affected by electron concentration and lattice distortion is discussed. A.

539.219

1338. THE SOLUTION OF INERT GAS ATOMS IN METALS. D.E.Rimmer and A.H.Cottrell.
Phil. Mag. (Eighth Ser.), Vol. 2, 1345-53 (Nov., 1957).

Estimates are made of the energies of interstitial and substitutional solutions of inert gas atoms in a simple metal. The loss of cohesion round such an atom is taken into account by regarding the atom as occupying a vacancy in the metal. Most of the energy of solution, particularly for the larger atoms, originates from the closed-shell interactions, which are estimated from interaction potentials based on data for the inert gases and on Huntington's potential for copper ions. Argon, krypton and xenon are expected to dissolve substitutionally in copper under all circumstances, even to the extent of forcing copper atoms off the lattice if no vacant sites are available. Neon should and helium may dissolve substitutionally when vacancies are available, but not otherwise. The strains round xenon and krypton atoms are so large that extra vacancies may be captured by these atoms to reduce the strain energy. The solubilities and diffusion of inert gas atoms in metals are briefly discussed in the light of these conclusions. A.

539.219

1339. INDIUM-RICH INDIUM–MAGNESIUM AND INDIUM–LITHIUM ALLOYS. J.Graham and G.V.Raynor.
Phil. Mag. (Eighth Ser.), Vol. 2, 1354-63 (Nov., 1957).

For comparison with the results obtained from alloys of indium with solute metals from Group IIB of the periodic table, the lattice spacings of indium–magnesium and indium–lithium alloys were measured. Although the results show an unexpected scatter, they establish that neither magnesium or lithium cause a marked axial ratio decrease. A possible reason for this behaviour is briefly discussed. The solid solubility of magnesium in indium at room temperature lies between 35 and 40 atom% of magnesium. The primary solid solution enters into equilibrium with the previously observed face-centred cubic intermediate solid solution (denoted β) above 275^0C, and with the ordered form of the same intermediate phase below this temperature. There is a peritectic reaction β + liquid ⇌ (indium-rich primary solid solution) at 333.5^0C. A.

539.26 : 539.213.2

1340. LOW-ANGLE X-RAY OBSERVATIONS ON GLASS. L.Cartz.
Nature (London), Vol. 180, 1115-16 (Nov. 23, 1957).

No low-angle diffraction was observed in heat-treated silica glass with monochromatic CuKα radiation. The effects observed by Hoffman and Statton (Abstr. 1648/1956) with nickel-filtered CuKα radiation were probably due to short-wavelength components. A.R.Stokes

539.27

1341. RECENT DEVELOPMENTS IN SPECIMEN PREPARATION TECHNIQUES FOR ELECTRON MICROSCOPY. V.E.Cosslett and R.W.Horne.
Vacuum, Vol. 5, 109-30 (Oct., 1955; publ. Nov., 1957).

ELASTICITY. STRENGTH. RHEOLOGY

539.31

1342. ON THE THEORY OF THE LOW-TEMPERATURE INTERNAL FRICTION PEAK IN METALS. H.Donth.
Z. Phys., Vol. 149, No. 1, 111-30 (1957). In German.

A detailed study of the mechanism proposed by Seeger (Abstr. 2736/1957). Pairs of kinks are formed in a dislocation line when its energy of oscillation about a potential energy minimum exceeds a critical value. This energy is obtained through interaction with the thermal vibrations of the lattice. The critical value is not reached spontaneously but by a series of small changes as in a stochastic process. The general theory of such processes is used to obtain an expression for the relaxation time for the formation of kink pairs. An activation energy is introduced and the theoretical expression for this is compared with a value obtained from measurements by Bordoni (Abstr. 9020/1954) and Niblett and Wilks (Abstr. 8434/1956) on the internal friction peak in copper. A value of 5×10^{-4} G is deduced for the Peierls stress in copper, where G is the shear modulus. D.M.Edwards

539.313 : 548.0

1343. THEORIES OF CRYSTAL ELASTICITY. N.Joel and W.A.Wooster.
Nature (London), Vol. 180, 430-1 (Aug. 31, 1957).

A model is proposed to illustrate how a crystal like selenium

could contain "volume-couples", such as are envisaged in Laval's theory ("L'etat solide", Rapports et Discussions, Congrès Solvay, 1951. Brussels: Stoops), in addition to stresses. Fifteen crystal classes are listed in which these effects could occur, and some experimental evidence for their occurrence is cited.

A.R.Stokes

539.32 : 534.22

1344. STUDY OF MECHANICAL PROPERTIES OF POLYETHYLENE AND PARAFFIN [OIL] BY A COMPOUND VIBRATOR METHOD. I.G.Mikhaĭlov and V.A.Solov'ev.
Akust. Zh., Vol. 3, No. 1, 65-73 (1957). In Russian.

The method and apparatus described in an earlier paper (Abstr. 4900/1956), enables measurements of the velocity of longitudinal waves and of mechanical losses to be made over a wide range of temperatures. Velocity of sound v. temperature curves for both substances are given. Experiments carried out at 40, 60, 75 and 100 kc/s, for both substances, show two maxima of (relaxation) losses. No dispersion was observed. Comparison of dielectric and acoustic measurements shows (a) the main relaxation regions coincide approximately, but (b) the relaxation spectra of electrical and mechanical processes show them to be different. C.R.S.Manders

539.32

1345. THE INTERNAL FRICTION OF COLD-WORKED COPPER AT LOW TEMPERATURES. D.H.Niblett and J.Wilks.
Phil. Mag. (Eighth Ser.), Vol. 2, 1427-44 (Dec., 1957).

The internal friction was measured in the temperature range 20° to 300°K, and a study made of the maximum in the curve of internal friction versus temperature first observed by Bordoni. The measurements indicate how the internal friction varies as a function of the amount of cold work, and also the effect of impurities in the metal and of neutron irradiation. The results are discussed with particular reference to recent theoretical treatments by Seegar.

A.

539.32

1346. THE ELASTIC CONSTANTS OF ICE.
R.Bass, D.Rossberg and G.Ziegler.
Z. Phys., Vol. 149, No. 2, 199-203 (1957). In German.

The elastic constants of ice in the temperature range −2 to −30°C are derived from measurements of the natural frequency of cylindrical rods and plates cut from single ice crystals (frequency range 5 to 30 kc/s). The results include a table of the elastic coefficients and moduli at −16°C, graphs of the variation of the coefficients with temperature and a diagram of the coefficient s_{11}' as a function of the angle between the rod axis and the c-axis.

H.J.H.Starks

539.373

1347.. ON THE MECHANICAL PROPERTIES OF INDIUM ANTIMONIDE. J.W.Allen.
Phil. Mag. (Eighth Ser.), Vol. 2, 1475-81 (Dec., 1957).

The deformation properties of indium antimonide were studied under a variety of conditions. At room temperatures elastic behaviour is observed up to the fracture point, while at higher temperatures glide occurs on $\{111\}$ planes. Impact at room temperature can cause glide on $\{110\}$ planes. A method of observing individual dislocations is described, and the dislocation distributions after the various deformations were studied. A.

539.374 : 534.2

1348. A NOTE ON STRESS PULSES IN VISCO-ELASTIC RODS. D.S.Berry.
Phil. Mag. (Eighth Ser.), Vol. 3, 100-2 (Jan., 1958).

Gives a brief mathematical treatment of the relationship between the transient stress in a semi-infinite visco-elastic rod and the attenuation coefficient and phase velocity as functions of steady state frequency. Except in the case of a delta function stress input, the expression obtained disagrees with Kolsky's result (1956). The reason for the failure of the latter is pointed out. A.

539.374.3

1349. DEFORMATION PROCESSES IN POLYETHYLENE INTERPRETED IN TERMS OF CRYSTAL PLASTICITY. F.C.Frank, A.Keller and A.O'Connor.
Phil. Mag. (Eighth Ser.), Vol. 3, 64-74 (Jan., 1958).

The rolling texture of drawn polythene is interpreted in terms of slip and twinning processes characteristic of ordinary crystal plasticity in combination with the rubbery elasticity characteristic of macromolecular amorphous substances. The principal crystal plasticity elements operative are (100)[010] slip and (310)[$1\bar{3}0$] and/or (110)[$1\bar{1}0$] twinning. The observations appear to indicate that (110)[$1\bar{1}0$] slip is a less easy mode of deformation than these, at least initially. Under more general deformation conditions, it appears that these modes predominate at small strain, tending to a texture with [010] aligned to the axis of extension, giving place to [001] slip processes, which align [001] and the molecular chains along the axis of extension when the strain is large. Under certain conditions a second crystalline phase also appears which in terms of general crystal plasticity would correspond to a martensitic type transformation and might arise through a regular sequence of stacking faults on $\{110\}$ planes. A.

539.389.4

1350. THE PLOTTING OF STRAIN-HYSTERESIS LOOPS. W.H.Cogill.
J. sci. Instrum., Vol. 34, No. 10, 396-8 (Oct., 1957).

The difficulty of measuring the small departures from linearity in the extension of steel specimens subjected to cyclic tensile loading was overcome in this case by comparing the extension of the specimen with that of a member of which the stress—strain curve is, by comparison with the specimen, linear. The scatter of the results obtained with this apparatus indicates that the accuracy of observation of a single strain-hysteresis loop is 4%. The effect was investigated of increasing the direct load while keeping the amplitude of alternating load constant. Stresses were confined to the normal working range. A.

539.501

1351. NON-NEWTONIAN FLUID FLOW. RELATIONSHIPS BETWEEN RECENT PRESSURE-DROP CORRELATIONS. A.B.Metzner.
Industr. engng Chem., Vol. 49, No. 9(I), 1429-32 (Sept., 1957).

The calculated relationships between pressure gradient and average velocity, in laminar flow of Bingham plastics and of "power-law" non-Newtonian liquids in pipes, are discussed. A criterion for the breakdown of laminar flow is suggested. J.G.Oldroyd

539.531 : 539.32

1352. THE MEASUREMENT OF MEYER HARDNESS AND YOUNG'S MODULUS ON THE ROCKWELL TEST MACHINE. D.K.Mackenzie and T.P.Newcomb.
Brit. J. appl. Phys., Vol. 8, No. 10, 398-9 (Oct., 1957).

A method is described in which the Rockwell hardness machine is used to determine the Meyer hardness and Young's modulus of a material. Meyer hardness values so derived for a number of materials are compared with those obtained from hardness measurements made on a Vickers hardness machine, and values of Young's modulus compared with figures quoted in standard tables. A.

539.61

1353. RELATIVE IMPORTANCE OF ELECTRIC AND DIFFUSION PROCESSES IN ADHESION PHENOMENA OF TWO POLYMERS. L.P.Morozova and N.A.Krotova.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 4, 747-50 (1957). In Russian.

Two groups of materials can be distinguished according to the phenomena accompanying the disruption of adhesion, one exhibiting electrical phenomena: luminescence in medium-vacuum, electron emission in high-vacuum and residual charges remaining on the separated surfaces, and the other containing non-polar components, where no electrical phenomena take place. The adhesion of the substances of the second group is based on an interdiffusion mechanism of the polymer chains in the contact zone.

Electrical Research Association

539.63 : 534.2

1354. ENERGY ABSORBED BY ELASTIC WAVES DURING IMPACT. S.C.Hunter.
J. Mech. Phys. Solids, Vol. 5, No. 3, 162-71 (1957).

The absorption of vibrational energy in the form of elastic waves generated by a transient localized force acting normally to the free surface of a semi-infinite solid is calculated in terms of the Fourier components of the force. The result is applied to the Hertzian collision of a small body with the plane surface of a massive specimen. It is concluded that for impact velocities small compared with the propagation velocity of elastic waves in the specimen, a negligible proportion of the original kinetic energy of the small body is transferred to the specimen by the collision. The result is of some interest in justifying the validity of the Hertz theory for collisions between a small and a massive body. While experimental evidence for the impact of steel ball bearings on massive glass specimens shows some measure of agreement with these theoretical conclusions, results obtained for steel specimens are somewhat at variance, the observed values of the coefficient of restitution (0.90-0.95) indicating absorption of 10%-20% of the initial kinetic energy of the ball. A possible explanation of this anomaly is the existence, at the high rates of strain involved in such collisions, of either anelastic or viscous (dissipative) forces in the steel. A.

539.89

1355. INVESTIGATION OF A SHOCK-INDUCED TRANSITION IN BISMUTH. R.E.Duff and F.S.Minshall.
Phys. Rev., Vol. 108, No. 5, 1207-12 (Dec. 1, 1957).

The structure of the shock-wave system to be expected in a material which can undergo a polymorphic transition is discussed. It is shown that the slope of the coexistence line in the p—T plane for the transition can be determined from shock-wave measurements at a given initial temperature. Shock waves produced by high explosives were used to investigate the equation of state of bismuth. An electrical contact technique was used to measure shock and free-surface velocities. The transition near 25 kilobars reported by Bridgman was observed but the transition pressure was about 3.5 kilobars higher than in static experiments. Other results indicated that recrystallization is a faster process than melting under shock conditions. Evidence suggests that the relaxation time for recrystallization in bismuth at 42°C and 27 kilobars is less than 1 μsec. A.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM. CHEMICAL REACTIONS

541.126

1356. MEASUREMENT OF CHAPMAN—JOUGUET PRESSURE FOR EXPLOSIVES. W.E.Deal.
J. chem. Phys., Vol. 27, No. 3, 796-800 (Sept., 1957).

The Chapman—Jouguet pressures of RDX, TNT, 64/36 Composition B, and 77/23 Cyclotol were measured by determining initial free-surface velocity as a function of thickness for 24ST aluminium plates in contact with the detonating explosive. An optical technique is described for the measurement of the velocities. The pressures determined for RDX, TNT, 64/36 Composition B, and 77/23 Cyclotol are 338, 189, 292, and 313 kilobars, respectively. A.

541.127

1357. RATES OF PARAMAGNETIC PULSE REACTIONS BY NUCLEAR MAGNETIC RESONANCE.
H.M.McConnell and S.B.Berger.
J. chem. Phys., Vol. 27, No. 1, 230-4 (July, 1957).

Certain fast chemical reactions involving both paramagnetic and diamagnetic molecular species are termed "paramagnetic pulse" reactions when each reaction event results in a change in a large hyperfine magnetic field acting at one or more of the molecular nuclei. The frequency distribution of the magnetic pulses is directly related to the reaction rate. The hyperfine intensity and frequency distribution of the paramagnetic pulses affects the nuclear magnetic resonance (n.m.r.) line shapes. The Bloch equations are used to establish a quantitative relation between nuclear resonance line shape, nuclear, and electron relaxation times, and the reaction rate. The theory is discussed in terms of the Cu^{63} n.m.r. work of McConnell and Weaver on electron exchange between Cu^{++} and Cu^{+} ions in hydrochloric acid solutions, and the H^1 n.m.r. work of Bruce, Norberg and Weissman on the electron exchange between neutral and positive ion molecules of N,N'-tetramethyl-p-phenylenediamine. A.

541.127

1358. RATES AND MECHANISMS OF PROTOLYSIS OF METHYL-AMMONIUM ION IN AQUEOUS SOLUTION STUDIED BY PROTON MAGNETIC RESONANCE.
E.Grunwald, A.Loewenstein and S.Meiboom.
J. chem. Phys., Vol. 27, No. 3, 630-40 (Sept., 1957).

The application of the nuclear magnetic resonance technique to the study of fast protolysis reactions of methylammonium ion in water is described. It is shown that reaction rates can be measured quantitatively for half-times in the range, 0.002 to 0.2 sec. Reaction rates were measured as a function of the methylammonium ion concentration and of the hydrogen ion concentration. Detailed information on the reaction mechanism was obtained by correlating the rate constants obtained from the CH_3, the NH_3^+ and the H_2O lines of the n.m.r. spectrum. In the pH range employed (between 3 and 5), the exchange rate is very nearly proportional to $[CH_3NH_3^+][CH_3NH_2]$, the second-order rate constant being 6×10^8 $sec^{-1} M^{-1}$ at 19°. Two separate reactions contribute to this rate constant. One of them, which accounts for about 40% of the total rate, is a direct proton transfer from $CH_3NH_3^+$ to CH_3NH_2. The other involves also at least one molecule of water, CH_3NH_2 receiving a proton from the solvation shell of $CH_3NH_3^+$ while simultaneously, or soon thereafter, a proton is transferred from $CH_3NH_3^+$ to the solvation shell. A.

541.127

1359. ION RECOMBINATION RATES IN METHANE—AIR FLAMES. I.R.King.
J. chem. Phys., Vol. 27, No. 3, 817-18 (Sept., 1957).

Using a development of the Langmuir probe technique, the decay of positive ion concentration was measured through and downstream of the flame front and values obtained for the recombination constant, α, of 2.5×10^{-7} cm^3/sec. It is shown that cooling of the gas by the probe does not cause error. A.G.Gaydon

PHOTOCHEMISTRY. RADIATION CHEMISTRY

541.14 : 535.89

1360. EXPLODING WIRE AS A LIGHT SOURCE IN FLASH PHOTOLYSIS. G.K.Oster and R.A.Marcus.
J. chem. Phys., Vol. 27, No. 1, 189-92 (July, 1957).

The method consists of discharging a bank of condensers, via a mechanical switch through a thin Nichrome wire. The wire explodes, emitting light rich in the ultraviolet region in less than a millisecond. The luminous efficiency in the 200 to 330 mμ region is of the order of 10% of the input. The minimum electrical energy input necessary to produce an explosion is equal to the energy required to vaporize the wire. The light output of the exploding wire as measured by uranyl oxalate actinometry and acetone photolysis is proportional to the electrical energy input. It was found to be highly reproducible. It was further observed that the exploding wire behaves as a line source. Because of the absence of a quartz of Pyrex tube in this source, it may find application in the far as well as in the near ultraviolet and in the visible spectral regions. A.

541.14

1361. REACTIONS OF ALKOXY RADICALS. I. PHOTOLYSIS OF METHYL ACETATE. M.H.J.Wijnen.
J. chem. Phys., Vol. 27, No. 3, 710-15 (Sept., 1957).

The photolysis of methyl acetate was investigated in the vapour phase over the temperature range 29 to 217°C at varying light intensities and initial pressures. The main primary step is a split of the ester molecule into CH_3CO and CH_3O radicals. The following reactions involving methoxy radicals were established:

$$CH_3O + CH_3 \rightarrow CH_2O + CH_4 \quad (A)$$
$$CH_3O + CH_3 \rightarrow CH_3OCH_3 \quad (B)$$
$$CH_3O + CH_3COOCH_3 \rightarrow CH_3OH + CH_2COOCH_3. \quad (C)$$

As activation energies for reactions (A) and (C) were obtained $E_A \leq 1.5$ kcal and $E_C \cong 4.5$ kcal. No information could be obtained regarding the extent to which reaction (D) occurred.

$$2\ CH_3O \rightarrow CH_3OH + CH_2O. \quad (D)$$

An activation energy of 10 kcal was obtained for the abstraction of a hydrogen atom from methyl acetate by methyl radicals. A.

541.14

1362. REACTIONS OF ALKOXY RADICALS. III. PHOTOLYSIS OF METHYL-d_3 ACETATE BELOW 100°C. M.H.J.Wijnen.
J. chem. Phys., Vol. 28, No. 2, 271-7 (Feb., 1958).

The photolysis of CH_3COOCD_3 was investigated at 90°C at varying initial pressures and light intensities. The following primary

steps were shown to occur:

$$CH_3COOCD_3 + h\nu \rightarrow CH_3CO + CD_3O \quad (1a)$$
$$\rightarrow CH_3 + CO_2 + CD_3 \quad (1b)$$
$$\rightarrow CH_3 + CO + CD_3O. \quad (1c)$$

The following reactions regarding methoxy and methyl radicals were investigated:

$$2CH_3 \rightarrow C_2H_6 \quad (3)$$
$$CH_3 + CD_3O \rightarrow CH_3OCD_3 \quad (6)$$
$$\rightarrow CH_3D + CD_2O \quad (7)$$
$$2CD_3O \rightarrow CD_3OD + CD_2O \quad (11)$$
$$CD_3O + CH_3COOCD_3 \rightarrow CD_3OH + CH_2COOCD_3 \quad (16)$$
$$\rightarrow CD_3OD + CH_3COOCD_2.$$

A value of about 1.4 was obtained for k_7/k_6 at 30 and 90° C, indicating the activation energy of reaction (7) to be zero kcal. Data obtained for the abstraction reactions (16) and (17) are discussed. Quantitative data have been obtained and are discussed for the disproportionation and recombination reactions of methyl and acetyl radicals. A.

DISPERSIONS. COLLOIDS. ADSORPTION

541.182.6 : 537.533.9

1363. ELECTRON MICROSCOPE STUDIES ON COLLOIDAL SILVER IODIDE EMPLOYING CINEMATOGRAPHIC TECHNIQUES. R.W.Horne and R.H.Ottewell.
Nature (London), Vol. 180, 910-11 (Nov. 2, 1957).

Sols of silver iodide have been produced having particles of various sizes between 10 and 5000 A. The behaviour of such particles under electron bombardment has been studied in an electron microscope with high resolution and a double condenser lens. The latter is essential for controlling the temperature of the specimens. Crystal growth was studied by taking a cine-film of the image on the fluorescent screen. Diffraction patterns were also obtained. The growth mechanism has not yet been fully elucidated. T.Mulvey

CHEMICAL STRUCTURE

541.64 : 535.435

SCATTERING OF LIGHT BY MACROMOLECULAR CHAINS IN SOLUTION. See Abstr. 999

CRYSTALLOGRAPHY

548.1

1364. SOME REMARKS CONCERNING THE PLANE LATTICE AND CLOSE-PACKING OF EQUAL CIRCLES. E.K.Broch.
Avhandl. Norske Vidensk. Akad. Oslo I, 1956, No. 3, 7 pp.

It is shown that no system of twinning can increase the density of packing of circles in a hexagonal array. A.R.Stokes

548.574

1365. HELICAL DISLOCATIONS AND SPIRAL ETCH-PITS. S.Amelinckx, W.Bontinck and W.Dekeyser.
Phil. Mag. (Eighth Ser.), Vol. 2, 1264-70 (Oct., 1957).

The etch-patterns due to helical dislocations are discussed. It is suggested that under certain conditions the etching of a helical dislocation gives rise to a spiral etch-pit of the kind observed on germanium and silicon crystals. Etch-patterns on (111) faces of fluorite crystals containing helical dislocations can readily be interpreted on the same basis. A.

548.574

1366. ON SPIRAL ETCH PITS IN GERMANIUM AND SILICON. S.G.Ellis.
Phil. Mag. (Eighth Ser.), Vol. 2, 1285 (Oct., 1957).

Suggests that these pits arise from dislocations in the form of helices by supposing that the lateral rate of etching is constant and that the point of nucleation moves in a circle. W.Bardsley

548.574

1367. ETCHING PATTERNS IN HIGH-PURITY ZINC. I.S.Servi.
Phil. Mag. (Eighth Ser.), Vol. 3, 63 (Jan., 1958).

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73

1368. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON X-RAY ANALYSIS — CARDIFF, APRIL, 1957. P.Gay and P.J.Wheatley.
Brit. J. appl. Phys., Vol. 8, No. 11, 427-35 (Nov., 1957).

A conference of the X-ray Analysis Group of The Institute of Physics. The topics discussed were the structures of minerals and inorganic compounds.

548.734.8

1369. SOME NOTES ON THE INTENSITY DISTRIBUTION ALONG THE X-RAY INTERFERENCE CIRCLES FOR SOME SIMPLE TYPES OF ORIENTATION IN POLYCRYSTALLINE SPECIMENS. P.H.Lindgren.
Ark. Kemi, Vol. 12, Paper 2, 9-32 (1957).

The orientation in a specimen, and the intensity distribution along the X-ray interference circles from fibre-oriented and simple spirally oriented materials, is discussed in connection with frequency functions related to the distribution of the crystalline positions within the oriented specimen. A method to obtain the frequency functions from experimentally determined intensity distributions is also discussed. Some examples of the frequency functions are numerically calculated. A.

548.735.4 : 535.42

1370. SOME IMPROVEMENTS IN THE OPERATION OF THE OPTICAL DIFFRACTOMETER. C.A.Taylor and B.J.Thompson.
J. sci. Instrum., Vol. 34, No. 11, 439-47 (Nov., 1957).

A systematic method of adjusting the components to bring their optical axes into coincidence is described. This is followed by an account of a theoretical study of the variation of partial coherence which leads to the formulation of a set of practical rules for choosing the correct size of pinhole for a particular problem. Some minor improvements in the design of the diffractometer and in the photographic techniques employed are also described. A.

548.736 : 539.2 : 539.18

CRYSTAL STRUCTURE OF TRANSITION METALS AND THEIR ALLOYS. See Abstr. 1281

548.74

1371. ELECTRON DIFFRACTION FROM CRYSTALS CONTAINING STACKING FAULTS. II. M.J.Whelan and P.B.Hirsch.
Phil. Mag. (Eighth Ser.), Vol. 2, 1303-24 (Nov., 1957).

The theory of Pt I (Abstr. 8950/1957) is applied to the case of stacking faults in close packed lattices. Electron-optical experiments on thin foils of stainless steel are described, the results of which are in good agreement with theory. A.

GEOPHYSICS

550.38

1372. THE REMANENT MAGNETISM OF SOME LAVAS IN THE DECCAN TRAPS.
E.R.Deutsch, C.Radakrishnamurty and P.W.Sahasrabudhe.
Phil. Mag. (Eighth Ser.), Vol. 3, 170-84 (Feb., 1958).

The magnetizations of over 400 basalt specimens from the Deccan Traps have been found to be aligned in general along a NNW—SSE to NW—SE axis dipping towards the south. The results are consistent with the supposition that India has drifted northwards through over 50° of latitude and rotated 25° anticlockwise within the last 70 million years. In all three localities, the poles corresponding to the upper rocks are nearer the present geographical poles than those from the lower flows. The discrepancy may represent a northward drift of India during the formation of the Deccan Traps, but there are other possible explanations and further data are necessary to elucidate the problem. A.

551.46 : 535.314

1373. ON THE FOCUSING OF SUNLIGHT BY OCEAN WAVES.
H.Schenck, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 7, 653-7 (July, 1957).

A common optical phenomenon observed in shallow water is the presence of bright lines or bands of light moving across the sea bottom at surface-wave velocity. It is shown that these regions of increased intensity are mainly produced by the refraction of sunlight at the wavy surface. The depth at which intensity peaks reach a maximum is shown to be a function of the wave shape, trochoidal or sinusoidal, and the wave dimensions. This depth increases as the wave becomes longer and flatter. Intensity peaks up to six times the average intensity level are predicted to be theoretically possible. A.

ATMOSPHERE. METEOROLOGY

551.508.5 : 621.317.39

1374. AN IONIZATION ANEMOMETER FOR BIOMETEOROLOGICAL MEASUREMENTS. V.Havlovic.
Slaboproudý Obzor, Vol. 18, No. 10, 712-15 (1957). In Czech.

The instrument consists of a sonde (or a probe) and bridge-type d.c. amplifier. The probe consists of two electrodes, one of which carries a radioactive source (α-rays). For unidirectional measurements, the electrodes of the probe are in the form of two parallel plates. The omnidirectional probe has a spherical source electrode and the collector electrode in the form of a spherical "cage" consisting of three rings. The source electrode is given a potential of +100 V and the current produced by the probe is measured across a 100 MΩ resistor which feeds into the amplifier. The instrument is also fitted with a small wind tunnel which is used for calibration purposes. Both probes have a linear velocity v. galvanometer-deflection response and can be used at velocities below 2m/s.
R.S.Sidorowicz

551.510.535

1375. ON THE REFLECTION COEFFICIENT OF THE IONOSPHERIC LAYERS. G.Pillet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 3, 335-8 (July 17, 1957). In French.

Arguments are advanced for the view that the reflection coefficient of an ionospheric layer is considerably less than unity when the layer is situated in the low ionosphere or when the collisional frequency is high. This is important in the interpretation of work on absorption when reflections from the E-layer are employed.
G.M.Brown

551.510.535

1376. DISTURBANCES IN THE F1 AND E REGIONS OF THE IONOSPHERE ASSOCIATED WITH GEOMAGNETIC STORMS. T.Sato.
J. Geomagn. Geoelect., Vol. 9, No. 1, 57-60 (March, 1957).

Results of an analysis of the behaviour of the parameters f_0F1, f_0E, h'F1, and h'E during magnetic storms are presented. These show variations which are, in all cases, similar to those well known for F2 parameters, and suggest a similar mechanism (electron drift) as the cause. G.M.Brown

551.510.535 : 523.746

1377. TRAVELLING DISTURBANCES IN THE IONOSPHERE: CHANGES IN DIURNAL VARIATION. G.H.Munro.
Nature (London), Vol. 180, 1252-3 (Dec. 7, 1957).

The monthly mean direction of horizontal movement of travelling ionospheric disturbances at Sydney showed no marked diurnal variation over the summer months of 1950-55, but a marked change from S.E. to S.W. occurred about noon for the summer months of 1956 and 1957. Examination of the diurnal variation on individual days suggests that the number of days on which this change is observed is related to sunspot activity. G.M.Brown

551.510.535 : 550.38 : 523.164.4

CORRELATION OF RADIO-STAR SCINTILLATIONS WITH GEOMAGNETIC AND IONOSPHERIC DISTURBANCES. See Abstr. 851-2

551.510.535 : 538.566.3 : 523.164.83

IONOSPHERIC STUDIES BY THE LUNAR RADAR TECHNIQUE. See Abstr. 854

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.326 : 551.594.5

1378. ELECTROPHOTOMETRIC INVESTIGATIONS OF THE BRIGHTNESS OF THE NIGHT SKY. S.F.Rodionov.
Optika i Spektrosk., Vol. 2, No. 5, 606-15 (1957). In Russian.

Presents the main results of the research carried out by the Physics Department of Leningrad University since 1948. Diurnal variations of infrared radiation of the night sky were disclosed. The distribution of energy in the emission spectrum of the night sky was measured in absolute units. The Galaxy was found to emit infrared radiation. Twilight radiation flashes of the upper atmosphere, both in the visible and infrared regions, were detected and studied. Diurnal variations of night-sky emission in the ultraviolet region were detected, and the distribution of this emission across the sky was measured. Positive correlation was found to exist between the infrared night-sky emission and solar activity. The infrared component of auroral emission was measured. It is suggested that, to understand the mechanism of excitation of the night-sky emission, one has to take into account the diffuse short-wave ultraviolet light of the sun, which is present at night in the upper layers of the atmosphere, owing to anomalous refraction and secondary diffusion. F.Lachman

551.521.6 : 535.343

LONG PATH WATER VAPOUR SPECTRA WITH PRESSURE BROADENING. See Abstr. 965-6

551.594.12

1379. SCATTER-FIELD STRENGTHS AND LARGE ION CONCENTRATION. S.C.Coroniti and N.C.Gerson.
J. atmos. terrest. Phys., Vol. 10, No. 4, 237-9 (1957).

Preliminary measurements of the variation with altitude of the concentration of large ions in the atmosphere indicate that this correlates well with the corresponding changes of refractive index, and is sometimes a more sensitive index of changes in the meteorological elements. It is therefore suggested that changes of large-ion concentration may be used as a more suitable atmospheric index in discussion of tropospheric scatter signals received beyond the horizon. G.M.Brown

551.594.2

1380. MECHANISM FOR PRODUCTION OF X-RAYS BY ION CLOUDS STRIKING THE EARTH. P.J.Kellogg.
Phys. Rev., Vol. 108, No. 4, 1093-4 (Nov. 15, 1957).

A mechanism is proposed whereby it is possible for electrons contained in a proton—electron cloud which is approaching the earth (producing geomagnetic storms and aurorae) to become accelerated and penetrate into the atmosphere to a depth comparable with that of proton penetration. It depends on the density of the cloud being high enough for the electrons and protons to affect each other, so that the electrons will accelerate in the electric field of the protons. On impinging on the atmosphere, the electrons will produce X-rays. G.M.Brown

551.594.21

1381. THE ORIGIN OF ELECTRIC FIELDS IN THUNDER-CLOUDS. SUPPLEMENT: ON MICRO PHENOMENA INSIDE A MACRO-SPACE. D.Müller-Hillebrand.
I.V.A. (Stockholm), Vol. 28, No. 6, 263-7 (1957). In Swedish with supplement in English, 268-72.

The origin of the electricity of thunderstorms is still imperfectly understood owing to the difficulty of investigating microscopic phenomena within macroscopic space. The contact processes between the supercooled water drops and the graupel grains (electrolytic charge separation), between the ice crystals and the graupel (contact electrification), and between ice crystals and graupel in the presence of an electric field (induced charges) are explained in relation to the charging of drops and droplets by ion diffusion and drift in the electric field. To explain the development with time of thunderstorm electricity, the following scheme is suggested: incubation time (diffusion processes), ripening time (ion drift in the electric field) and breaking-out time (ice-phase processes). An illustrated historical account of the study of ice crystal and graupel formation is given as a supplement. G.N.J.Beck

551.594.221

1382. ELECTRIC FIELD CHANGES DURING CLOUD-TO-CLOUD LIGHTNING DISCHARGES.
S.R.Khastgir, B.A.P.Tantry and R.S.Srivastava.
J. sci. industr. Res., Vol. 16B, No. 7, 318-20 (July, 1957).

Oscillographic studies of cloud-to-cloud strokes were made over a period of several years. It is concluded that such strokes exhibit certain features in common with cloud-to-ground strokes, e.g. multiple strokes and pre-discharges. Oscillograms are shown and briefly discussed. J.D.Craggs

BIOLOGY

591.185 : 597.8

1383. OBSERVATIONS ON MODELS OF THE BASILAR PAPILLA OF THE FROG'S EAR. W.A.van Bergeijk.
J. Acoust. Soc. Amer., Vol. 29, No. 11, 1159-63 (Nov., 1957).

Observations on models of the tectorial membrane in the basilar papilla of the frog are described. The model membranes constitute a series of increasing complexity, and are studied with sinusoidal stimulation and stroboscopic illumination. It is found that travelling waves occur on these models, and that frequency-dependent maxima are formed. By arrangements of fibres and small masses on the membranes the direction of wave travel and location of maxima can be altered. Measurements of the elastic gradients on the membranes show that waves tend to follow a path defined by the smallest change in elastic properties per unit distance. It is concluded that the frog's basilar papilla is capable of performing frequency analysis according to the place principle. A.

591.485 : 598.2

1384. ACOUSTIC IRRITATION THRESHOLD OF PEKING DUCKS AND OTHER DOMESTIC AND WILD FOWL.
G.J.Thiessen, E.A.G.Shaw, R.D.Harris, J.B.Gollop and H.R.Webster.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1301-6 (Dec., 1957).

When exposed to sounds of sufficient intensity Peking ducks respond in a characteristic manner combining head shaking and tail twitching. The response rate (number of responses per unit-time) increases with intensity up to a certain level, but falls with further increase in intensity. There is no response at intensities lower than a certain critical value which may therefore be described as the irritation threshold. Prolonged exposure to sound leads to a more or less exponential drop in response rate but recovery is rapid during rest periods. Measurements on about thirty ducks indicate that the threshold has a broad minimum at about 500 c/s and the average value at this frequency is about 70 dB (sound pressure levels are given with respect to 0.0002 dyne/cm^2) with a range of 65-85 dB. There is some indication that the threshold is slightly lower for warble tones. At 15 and 18 kc/s no consistent responses have been obtained up to 115 and 120 dB, respectively. Similar experiments with chickens and geese showed fewer responses and hence much less accurate results. It has also been shown that hungry Peking ducks are greatly discouraged from taking food placed in a low frequency sound field at 100 dB intensity. A.

591.485 : 598.2

1385. ACOUSTIC IRRITATION THRESHOLD OF RINGBILLED GULLS. G.J.Thiessen and E.A.G.Shaw.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1307-9 (Dec., 1957).

When exposed to high-intensity sound, ringbilled gulls do not, to any extent, show the head-shaking reaction that was previously observed for ducks (see preceding abstract). They do, however, show a great tendency to cringe or crouch and are also subject to a temporary change in the rate of heart beat. These reactions are used to define and measure an acoustic "irritation threshold" at different frequencies between 100 and 3000 c/s. The threshold determined with reference to the cringing reaction is remarkably reproducible over a period of weeks (having an average minimum value of about 85 dB at 400 to 500 c/s) but rises considerably during the first eleven months of the bird's life. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

612.8 : 534.831

1386. PERFORMANCE ON A SIMPLE VIGILANCE TASK IN NOISE AND QUIET. H.J.Jerison.
J. Acoust. Soc. Amer., Vol. 29, No. 11, 1163-4 (Nov., 1957).

Twenty subjects, working individually, monitored a simple vigilance (level of attention or alertness) task, a modified "Mackworth Clock Test", for 1$\frac{3}{4}$ hr in noise (112.5 dB S.P.L.) and for 1$\frac{3}{4}$ hr in quiet (79 dB S.P.L.). In this test a stepping hand of a blank-faced clock was monitored, and subjects responded when they noticed an infrequently occurring double jump. No difference in efficiency attributable to noise level was found. This result is in conflict with previous reports from this and other laboratories which ascribed a decrement in performance on vigilance tasks to noise levels. Vigilance tasks in which performance decrements due to noise were found, differed from the present task in that they required subjects to scan a series of displays in addition to maintaining a vigil over each display. It is, therefore, suggested that flexibility of attention may be affected by noise, whereas vigilance without the requirement for flexibility may be unaffected. A.

612.84

1387. SOURCES OF ENTOPTIC STRAY LIGHT.
D.W.DeMott and R.M.Boynton.
J. Opt. Soc. Amer., Vol. 48, No. 2, 120-5 (Feb., 1958).

A technique is described for photographing the light scattered from the various ocular media. The results indicate that about 70% of scattered light stems from the cornea, the remainder from the lens. A.

612.84

1388. BLURRING OF OBJECTS MOVING RELATIVE TO OBSERVER. M.S.Sodha and S.S.Mitra.
J. sci. industr. Res., Vol. 16B, No. 8, 372-3 (Aug., 1957).

An expression is derived for the blurring of moving objects in terms of "magnitude of sensation". R.A.Weale

612.84

1389. SOME FURTHER VISUAL PHENOMENA ASSOCIATED WITH REGULAR PATTERNED STIMULATION. D.M.MacKay.
Nature (London), Vol. 180, 1145-6 (Nov. 23, 1957).

A brief account is given of more after-effect phenomena which result when (a) a source of visual noise is viewed after the presentation of a coherent stimulus, and (b) a set of concentric circles is viewed with or without central fixation. R.A.Weale

612.843.31

1390. WAVELENGTH DISCRIMINATION FOR POINT SOURCES.
R.E.Bedford and G.W.Wyszecki.
J. Opt. Soc. Amer., Vol. 48, No. 2, 129-35 (Feb., 1958).

Wavelength discrimination curves were measured for two normal trichromats for three field sizes and various intensities. In order to obtain high-intensity levels in the blue region, a high-pressure xenon arc was used as a source. Results for the 1° field agree essentially with those of previous workers. The higher blue intensities led to the establishment of a definite minimum at 420 mμ.

Results for the smaller field sizes differ considerably from previous data. The chief reason for this seems to lie in the viewing technique used. While previous authors employed strict fixation, this paper reports data obtained with a scanning technique. The effect of different methods of plotting is briefly discussed. A.

612.843.31

1391. SOME COLOR NAMING EXPERIMENTS FOR RED AND GREEN MONOCHROMATIC LIGHTS.
M.A.Bouman and P.L.Walraven.
J. Opt. Soc. Amer., Vol. 47, No. 9, 834-9 (Sept., 1957).

Instability in the colour appreciation of monochromatic flashes for a normal trichromat is studied with respect to the instability in the stimulus due to the statistical fluctuation in the number of incident quanta and the distribution of this number over the retinal receptors. The frequencies of reddish, yellowish, greenish, bluish, colourless, white, etc., appearances in the perception were determined under variation of brightness, wavelength, exposure time, and area of the test stimulus. By comparison with the quantum theoretical studies conducted previously for absolute threshold values, it is found that for green excitation, three quanta, and for red, two quanta are required for a coloured perception. For the long wave end two systems are sensitive, a "red" and a "colourless" system. In the green two quanta excitations result in colourless appearances of the perception. A.

612.843.31

1392. CHROMATIC FLICKER FUSION FREQUENCY AS A FUNCTION OF CHROMATICITY DIFFERENCE. C.V.Truss.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1130-4 (Dec., 1957).

The critical colour fusion frequency (c.c.f.f.) was measured for each of fifteen pairs of six colours at equal luminance. Measurements were made at five levels of luminance ranging from 9 to 67 trolands. Two subjects were used. The six colours were of high chromatic purity. Their dominant wavelengths covered the range of 445 mμ to 670 mμ in nearly equal steps. The relative chromatic separation between the members of each pair was estimated from Judd's R.U.C.S. and from Wright's data on the size of equally noticeable colour steps in the C.I.E. chromaticity diagram. The results show that log reciprocals of c.f.f. and c.c.f.f. are nearly parallel and linear functions of luminance in log trolands. The product-moment correlation between persistence (1/c.c.f.f.) and log chromatic separation on the R.U.C.S. was 0.84 and 0.91 when log chromatic separation was computed from Wright's data. A.

612.843.37

1393. STUDIES OF ROD-PROCESS TO SUPRATHRESHOLD LIGHT STIMULI WITH A DIRECT CURRENT METHOD.
D.Yonemura and R.Nango.
J. Opt. Soc. Amer., Vol. 47, No. 9, 822-7 (Sept., 1957).

A direct current method is described for measuring the magnitude of excitation of rods in the human eye adapted to suprathreshold light stimuli. The method is in principle based on the finding that the electrostimulation, with a single constant current pulse of about 25 milliseconds in duration, exercises a selective effect on the rod mechanism. By means of this technique, rod responses to spectral lights are measured at a temporal retinal region of 15 degrees from the fovea as a function of wavelength. The spectral distribution of rod responses determined in this manner is found to agree satisfactorily with the scotopic visibility curve. Rod responses to a weak white light stimulus are measured at various parts of the retina. The spatial distribution of rod responses so obtained is found to show close resemblance to the rod density distribution of Oesterberg. The magnitude of rod responses increases with the increasing intensity of stimulus light, but decreases at a certain intensity and above it. This fact suggests the inactivity of rods in photopic vision, thus verifying the original idea of von Kries that the rods act only in twilight vision and not at all in day vision. A.

612.843.613

1394. NOISE AND THE VISUAL THRESHOLD.
M.G.Bulmer and C.I.Howarth; V.Cane and R.L.Gregory; H.B.Barlow.
Nature (London), Vol. 180, 1403-4, 1404-5, 1405 (Dec. 21, 1957).

This is a largely theoretical discussion on the interpretation of curves relating the differential or incremental threshold (ΔI) to a level of adaptation I. On the experimental side, Cane and Gregory show that when ΔI is plotted against I for different ages a family of straight lines is obtained which differ in slope but have a constant intercept on the I axis. (This is unexpected because their theory implies that the intercept varies with the transmissivity of the ocular media, which is thought to decrease significantly in the age range here examined). R.A.Weale

612.843.613

1395. RETINAL SUMMATION AND HUMAN VISUAL THRESHOLDS. R.A.Weale.
Nature (London), Vol. 181, 154-6 (Jan. 18, 1958).

It is suggested that, when allowance has been made for differing receptor densities and retinal integration factors, the thresholds of rods and cones are of the same order even for test-fields subtending at the eye a diameter of as much as 1°. R.A.Weale

612.843.72

1396. CONTOUR PERCEPTION, ILLUSION AND REALITY.
V.O'Brien.
J. Opt. Soc. Amer., Vol. 48, No. 2, 112-19 (Feb., 1958).

A qualitative analysis of the perception of contours indicates that, to counteract the filtering characteristics of the eye, there may be a process of contour enhancement by a second difference correction. By simple experiments, contours corresponding to true edges, contours perceived although there are no edges in the external intensity distribution, and certain aspects of contrast are investigated with results that show agreement with such a process. A.

612.843.72

1397. INFLUENCE OF STIMULUS LUMINANCE UPON THE UPPER SPEED THRESHOLD FOR THE VISUAL DISCRIMINATION OF MOVEMENT. R.H.Brown.
J. Opt. Soc. Amer., Vol. 48, No. 2, 125-8 (Feb., 1958).

The observer viewed the centre of a circular black area surrounded by a dimly illuminated area. A small moving spot of white light traversed the path of a horizontal line centred in the circle. At high speeds, the observer reported a stationary line and could not indicate the direction of movement. At slow speeds, he indicated the direction (right or left). Three subjects made observations for different combinations of luminance and speed of the moving spot. The threshold luminance for visibility of either the moving spot or stationary line increased directly with the stimulus speed. The threshold luminance for discrimination of motion of the moving spot also increased directly with its speed but approached infinity for a limiting asymptotic velocity at high speeds. The upper speed threshold increased directly with luminance at moderate luminances. At intense luminances, the upper speed threshold was approximately constant (35° of visual angle per sec). A.

612.843.72 : 77

1398. SHAPE AND SIZE CONSTANCY IN PHOTOGRAPHIC REPRODUCTIONS. H.Leibowitz, T.Bussey and P.McGuire.
J. Opt. Soc. Amer., Vol. 47, No. 7, 658-61 (July, 1957).

The extent to which shape and size constancy are preserved in photographic reproductions was investigated by comparison of the constancy effect in both test objects and photographs of the test objects. For shape, the photograph reduces the amount of constancy by less than 50%. However, for size, there is very little constancy obtained with the photograph. For test objects, binocular observation gives higher constancy for both size and shape than does monocular viewing. For photographs, there is little or no difference between monocular and binocular observation. The implications of the data are discussed in relation to the theory of the corresponding perceptual processes. A.

612.85 : 534.831

1399. HEARING LOSS AMONG AIR FORCE FLIGHT-LINE PERSONNEL. L.L.Kopra.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1277-83 (Dec., 1957).

As a part of an investigation on the hearing acuity of Air Force personnel, pure-tone audiometric tests and job, noise, and medical history questionnaires were administered to 996 flight-line personnel. For 16 Air Force Specialty groups mean hearing losses (better and worse ear) at 4000 c/s ranged from 1.8 dB to 20.7 dB re audiometer zero. Worse-ear hearing losses at 3000 c/s and at 4000 c/s in nine Air Force Specialty groups (N = 854) did not differ significantly from one group to another. Significant positive correlation was found when 4000 c/s hearing loss was correlated with age and when 4000 c/s hearing loss was correlated with length of noise exposure. However, when the positive hearing loss v. exposure correlation was adjusted for the positive relationship between age and exposure, no remaining statistically significant relationship existed between 4000 c/s hearing loss and length of noise exposure. Infrequent use of ear protection is interpreted as evidence indicating a real need for effective noise and ear-protection indoctrination of personnel exposed to high-level on the job noise. A.

612.85 : 534.831

1400. HEARING OF NAVAL AIRCRAFT MAINTENANCE PERSONNEL. W.D.Ward.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1289-301 (Dec., 1957).

Audiograms were obtained on 1200 naval enlisted men. Although hearing losses were slightly greater among men who were or had been exposed to noise from reciprocating engines and jets without afterburner, this is probably due to the fact that these men have also been exposed to more gunfire. Follow-up audiograms taken on 220 of these men (all men in three squadrons whose planes had afterburners) revealed no additional hearing loss after seven months of moderate exposure. A similar negative result was found in a study of flight-deck personnel during a three-month cruise aboard an aircraft carrier. A.

612.85

1401. THRESHOLD OF HEARING AND EQUAL-LOUDNESS RELATIONS FOR PURE TONES, AND THE LOUDNESS FUNCTION. D.W.Robinson and R.S.Dadson.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1284-8 (Dec., 1957).

During recent years a programme of work has been in progress at the National Physical Laboratory with the objective of providing improved data on several aspects of subjective acoustics. In connection with standards for audiometry, measurements have been made of the threshold of hearing for pure tones by earphone listening, and these have since been extended to the case of listening in free field. Latterly a redetermination of the equal-loudness relations for pure tones has been completed aimed at resolving discrepancies between former determinations and providing an improved basis for the establishment of a standard set of contours. These results apply to a large team of otologically normal observers, and cover the range from 25-15 000 c/s and up to 130 dB in sound-pressure level. The results of this investigation enable the equivalent loudness of any pure tone to be expressed by simple formulae with coefficients varying smoothly with frequency. Considerable attention has also been devoted to the determination of the loudness scale, i.e., the function relating loudness level in phons to the magnitude of the loudness sensation expressed on the sone scale. An assessment of the experimental evidence has led to the formulation of a simple relation which appears adequate for practical purposes in noise measurement. Investigations are continuing on the determination of loudness levels of complex sounds from their objective spectra. A.

612.85

1402. FURTHER OBSERVATION ON PITCH ASSOCIATED WITH A TIME DIFFERENCE BETWEEN TWO PULSE TRAINS. W.R.Thurlow.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1310-11 (Dec., 1957).

Changing the time separation between two trains of filtered pulses, each at the same basic repetition rate, makes it evident that there is a pitch which is correlated with the magnitude of the time separation. When both trains of pulses are at 30 dB sensation level, decreasing the intensity of one train of pulses by 10 dB results in a noticeable asymmetry in the production of the "time-difference" pitches. That is, the "time-difference" pitches are much stronger when the pulses of the less intense train are in the second half of the interval between the pulses of the more intense train. No differences in spectra of the stimuli have been found which could explain this asymmetry. A.

612.85

1403. SOME IMPEDANCE MEASUREMENTS ON NORMAL AND PATHOLOGICAL EARS. J.Zwislocki.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1312-17 (Dec., 1957).

The acoustic method of impedance measurement at the eardrum, described in the preceding paper (Abstr. 5778/1957) has been improved and applied to the investigation of the effect of some pathological changes in the middle ear on the measured impedance. The investigation shows that the otosclerosis and the interruption of the ossicular chain can be easily detected by means of the impedance measurement. An electrical and mathematical model of the dynamics of the middle ear is developed. A.

TECHNIQUE. MATERIALS

PHOTOGRAPHY

771.53

1404. NOTE ON THE SELWYN FUNCTION WITH IMPERFECT IMAGERY. J.E.Wilkins, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 10, 975 (Oct., 1957).

Differences between the observed standard deviations (σ) of density fluctuations in an emulsion, and those predicted by the Selwyn theory, may be due to diffusion of the grain images on the phototube. Assuming this diffusion, the resulting formula expressing the relation between σ and the diameter of the scanning aperture was numerically integrated by Zweig (Abstr. 994/1957) to obtain a partial fit between theory and experiment. Explicit evaluation of the formula gives a somewhat better fit, and this can be improved further by a different selection of constants. S.T.Henderson

771.53

1405. PHOTOGRAPHIC SEQUENCE EXPOSURE EXPERIMENT. J.H.Enns and E.Katz.
J. Opt. Soc. Amer., Vol. 47, No. 8, 758-64 (Aug., 1957).

An instrument is described which was built for the automatic recording of sequence exposures on 4 by 10 in. photographic plates. Twelve shutter slides are independently timed so that on one plate up to 384 4 by 5 mm rectangles can be uniformly exposed to high and low intensity radiation. The design is for an intensity ratio of 100 : 1, where both intensities are below optimum. With minor modifications the instrument can be converted to operate at other intensity ratios. The densitometer readings are checked from calibration strip data placed adjacent to the sequence exposures. The corrected data, following conversion to Seidel values, are plotted as families of characteristic curves, with the sequence exposure ratio as the constant parameter. Isodense loop data are read from the curves at the intersection with a line drawn parallel to the exposure axis. A theoretical discussion of isodense loops is presented which is based on the hypothesis that for isodense exposures the probability of rendering the last grains developable must be equal. It is shown how this method should yield the limiting slope of the low intensity failure curve and the minimum number of quanta absorbed by the average grain to become developable. Preliminary results for Eastman Kodak Emulsion Type 33 are within expectation. A.

771.534.5

1406. LOW-TEMPERATURE RECIPROCITY FAILURE OF PHOTOGRAPHIC EMULSIONS AND THE TEMPERATURE DEPENDENCE OF SENSITIVITY. G.C.Farnell.
J. Opt. Soc. Amer., Vol. 47, No. 9, 843-9 (Sept., 1957).

The observations of Biltz that, under certain conditions, reciprocity failure occurs at low temperatures (e.g., -196°C) have been confirmed. The failure is only of the high-intensity type and is restricted to emulsion–developer combinations of relatively low sensitivity, in particular, to surface image development of nonchemically-sensitized emulsions. At -196°C, the effect is exhibited most readily by silver bromo-iodide emulsions. The effect represents an intensity-dependent recombination of electrons and positive holes released in a grain at low temperatures, thus modifying the number of electrons available for latent-image formation on warming up. The mechanism proposed for superlinear fluorescence adequately accounts for all observations and the connection between low-temperature reciprocity failure and fluorescence of the silver halides is established. The description of the dependence of sensitivity on temperature is revised. It is now apparent that, with certain emulsion–developer combinations, the speed loss from the normal temperature optimum to a low temperature may contain a factor additional to the absorption and ordinary high-intensity-failure speed losses. A.

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957) and the Supplement published with the Index to the same volume. Reprints of the List of Journals and of the Supplement can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Acta chem. Scand.	Acta Chemica Scandinavica. Ejnar Munksgaard, Nörregade 6, Copenhagen
Acta metallurgica	Acta Metallurgica. The Board of Governors of Acta Metallurgica, P.O. Box 1088, Schenectady, N.Y. Publishers: Pergamon Press (Acta Metallurgica), 122 East 55th Street, New York 22, N.Y.
Acta Polytech. Scand.	Acta Polytechnica Scandinavica, Sub-series: Electrical Engineering, El; Mathematics and Computing Machinery Ma; Physics including Nucleonics, Ph. The Scandinavian Council for Applied Research. Publishing Office: P.O. Box 5073, Stockholm 5.
Avtomat. i Telemekh.	Avtomatika i Telemekhanika. Akademiya Nauk SSSR, Cherkasskiĭ per., 2, Moscow.
Elektronik	Elektronik. Franzis-Verlag, Karlstrasse 35, Munich 2.
J. Phys. Chem. Solids	Journal of Physics and Chemistry of Solids. Pergamon Press, 122 East East 55th Street, New York 22, N.Y., and 4 and 5 Fitzroy Square, London, W. 1.
Ontario Hydro Res. News	Ontario Hydro Research News. [Abstracted by the Electrical Research Association.]
Prace Inst. Łączności	Prace Instytutu Łączności. Instytut Łączności, ul. Ratuszowa 11, Warsaw 4.
Prace Inst. Tele- i Radiotech.	Prace Instytutu Tele- i Radiotechnicznego. Instytut Tele- i Radiotechniczny, ul. Ratuszowa 11, Warsaw 4.
Spectrochimica Acta	Spectrochimica Acta. Pergamon Press, 4 and 5 Fitzroy Square, London, W. 1.
Wiss. Abhandl. Arbeitsgemeinschaft Forsch. Landes Nordrhein-Westfalen.	Wissenschaftliche Abhandlung der Arbeitsgemeinschaft für Forschung des Landes Nordrhein-Westfalen. Westdeutscher Verlag, Ophovener Strasse 1-3, (22a), Opladen/Rhld.

NOTES

Central Electricity Generating Board Digest	This signature is now used for the abstracts formerly signed "Central Electricity Authority Digest".
Cienc. y Tec.	Ciencia y Tecnica. Centro Estudiantes de Ingenieria. Address changed to: Centro Estudiantes de Ingenieria, "La Linea Recta", Paseo Colon 850, Buenos Aires.

ERRATA

Author Index (1957) p. 974, column 2 : for "Jergers,J.F." read "Jerger,J.F."
Author Index (1957) p. 989, column 1 : Lévy,M.; transfer entry "Radiation coloration in glasses, 1664" to be under "Levy,M."
Abstr. 638 (1958) line 1 : for "ABERRATION" read "ABERRATIONS".
Abstr. 817 (1958) line 7 : for "Vol. 25" read "Vol. 125".

AUTHOR INDEX

Abragam,A., 1025
Abrahams,E., 1313
Ader,M., 1230
Adrian,F.J., 1331
Agar,A.W., 1092
Agranovich,V.M., 1004
Agu,B.N.C., 1166
Aiyama,Y., 1133
Aizu,K., 1154
Alberigi-Quaranta,A., 1179
Albertoni,S., 875
Aleksanyan,V.T., 968
Allen,J.W., 1347
Allen,T.L., 1296
Alles,W., 1197
Almeida,I.G., 1116
Al'mukhamedov,A.G., 930
Alvial,G., 1149
Alyea,E.D., Jr, 1145
Amati,D., 1188, 1195-6 1201, 1203
Ambler,E., 1243
Amelinckx,S., 1365
Anderson,H.L., 1186
Anderson,J.M., 1078-9
Andrade e Silva,J., 887
Andrew,K.L., 949
Annis,M., 1175
Armenteros,R., 1205
Arndt,D., 843-5
Arthurs,A.M., 1287
Asaro,F., 1237
Ashmore,A., 1270
Aslam Khan,M., 955
Astafurov,A.V., 990
Astier,A., 1205
Austin,I.G., 1049
Avery,D.G., 1067
Azuma,R.E., 1251

Bagguley,D.M.S., 1316
Bailey,R., 1096
Baird,K.M., 958
Bakhshiev,N.G., 948, 995
Baldwin,J.E., 853
Ballario,C., 1210
Bansigir,K.G., 1002
Barakat,N., 996
Barkas,W.H., 1184
Barlow,G.S., 1315
Barlow,H.B., 1394
Barnes,R.S., 1323
Barrow,R.F., 954
Barton,J.C., 1113
Bass,R., 1346
Bassi,P., 1208, 1212
Bastin,J.A., 1050
Batemen,S., 991
Battaglia,A., 960, 971
Bayet,M., 1102-3
Beard,D.B., 1252
Bebchuk,A.S., 927
Becker,E.D., 1294-5
Bedford,R.E., 1390
Beljers,H.G., 1130
Bennett,L.H., 1293
Benoist,P., 1259
Benoit,H., 999
Berencz,F., 889-90
Berger,S.B., 1357
Berghausen,P.E., 1032
Berkowitz,J., 1298-9
Berry,D.S., 1348
Bersuker,I.B., 957
Bertolini,G., 1239
Besson,C., 1187
Bettoni,M.M., 1239
Bhatki,K.S., 1232
Biel,S.J., 1220
Biswas,N.N., 1197
Bizzari,R., 1210
Bizzeti,P.G., 1148
Blackman,M., 1129
Blevis,B.C., 854
Bloch,M., 1191
Boag,J.C., 1150
Böbel,G., 1160 [1101
Boerboom,A.J.H., 1098,
Bogdanova,I.P., 1280
Bollini,C.G., 873
Bond,C.D., 1268
Bondarenko,R.N., 1056
Bonetti,A., 1149
Bonnelle,C., 1083
Bonnor,W.B.,908
Bontinck,W., 1365
Boot,H.A.H., 1137
Booth,D.L., 1260
Borelius,G., 1041
Borelli,V., 1208, 1212
Bouman,M.A., 1391
Boynton,R.M., 1387
Bransden,B.H., 1265
Braunstein,R., 1139
Breidt,P., Jr, 1051
Brewer,D.F., 1023
Briggs,D.K.H., 1019
Broadbent,D., 1179
Broch,E.K., 1364
Bromilow,N.S., 940
Broten,N.W., 849
Brown,A.F.C.(Conf. rep.). 896
Brown,G.L., 1212
Brown,J.L., 1213
Brown,R.H., 1397
Browne,M.T., 918
Bruin,F., 960, 971
Brunelli,B., 1210
Buchbinder,H., 936
Bulanin,M.O., 967
Bulmer,M.G., 1394
Burbidge,E.M., 861
Burbidge,G.R., 861
Burdett,T., 1166
Burgy,M.T., 1173
Burns,J., 1337
Bursian,É.V , 1328
Burwell,J.R , 1193
Busbridge,I.W., 862
Bussey,T., 1398
Byers,N., 1269

Cabannes,M.P., 1230
Candela,G.A., 1279
Cane,V., 1394
Carter,C., 1085
Cartz,L., 1340
Ceccarelli,M., 1197
Ceolin,C., 1206
Chadan,K., 877
Chagnon,P.R., 1234
Chandrasekhar,S., 1010
Chen-Gi-Tkhek, 1280
Chirikov,B.V., 1089
Christian,J.W., 1327
Christiansen,W.N., 850
Chupka,W.A., 1298-9
Churchill,J.L.W., 1096
Churchill,S.W., 1020-1
Churchman,A.T., 1332
Ciok,P., 1117
Clark,G.W., 1110
Cline,J.E., 1234
Clusius,K., 907
Cogill,W.H., 1350
Cohen,M.H., 1314
Collins,J.G., 994
Colombani,A., 1061
Conforto,A.M., 1112
Conte,P., 1230
Conversi,M., 1208, 1212
Cook,A.H., 863, 997
Coombes,C.A., 1194
Corbey,M.M.G., 1072
Cork,B., 1194
Coroniti,S.C., 1379
Cosslett,V.E., 1341
Costa,N.L., 1116
Cottrell,A.H., 1323, 1332, 1338
Cousins,J.E., 1181
Covington,A.E., 849
Crawford,F.S.,Jr, 1207
Cresti,M., 1207
Cronin,J.W., 1213
Crosswhite,H.M., 946
Crussard,J., 1187, 1197
Cutler,D., 1221

Dadson,R.S., 1401
Dagg,M., 851-2
Dahlin,B.E., 1229
Dalton,A.W., 1261
D'Andlau,C., 1205
d'Andlau,C.A., 1107
Danielson,R.E., 1115
Danysz,M., 1117
Dapoigny,J., 916
Darwin,C.G., 867
Das,T.P., 1282
Dawton,R.H.V.M., 910
Deal,W.E., 1356
Dearnaley,G., 1255
Deigen,M.F., 972
Dekeyser,W., 1365
Della Corte,M., 1148
Dell'Antonio,G., 876
De Marco,A., 1210
DeMott,D.W., 1387
de-Shalit,A., 1162
Desnoyers,J.E., 1029
d'Espagnat,B., 880
DeStaebler,H.C., 1205
Destouches,J.L., 864
Deutsch,E.R., 1372
Deutsch,S., 977
de Vries,H.L., 1228
de Waard,H., 1235
Di Capua,E., 1210
Dieke,G.H., 985
Dillon,T.J., 1104
Dilworth,C., 1149
Din,F.(Conf. rep.), 1022
Dingle,H., 867
Dingle,R.B., 843-7
Dissanaike,G.A., 1255
Dobbs,E.R., 1304
Dobronravov,Yu.A., 1274
Donth,H., 1342
Douglas,A.C., 1265
Drake,W.D., 1019
Dreyfus-Graf,J., 928
Drickamer,H.G., 937
Duckworth,H.E., 1285
Duff,R.E., 1355
Duimio,F., 875-6
Dunina,A.A., 979

Eastabrook,J.N., 1012,1028
Eberhard,P., 1158, 1266
Eckhardt,G., 936
Edels,H., 1065
Edmonds,P.D., 923
Edwards,A.G., 1334
Edwards,D.H., 922
Edwards,D.O., 1023
Edwards,S.F., 1074
Effat,K.E.A., 1097
Egorov,V.S., 945
Eisenberg,Y., 1157, 1204
Eisler,F., 1208, 1212
Elcock,E.W., 1124
Elliott,G., 1054
Ellis,S.G., 1366
Enns,J.H., 1405
Enoch,J., 1190
Epstein,R.J., 1173
Eshelby,J.D., 1322
Essen,L., 868
Evans,J.V., 855
Everhart,T.E., 1093

Fabelinskiĭ,I.L., 1000
Fabre,D., 992
Facchini,U., 1238
Faĭdysh,A.N., 982
Faris,F.E., 1273
Farnell,G.C., 1406
Fasoli,U., 1111
Fastie,W.G., 946
Faucher,J.A., 1003
Fedorov,F.I., 932-3
Fedorus,G.A., 1066
Ferrari,F., 1211
Ferrell,R.A., 1165
Ferretti,B., 878, 1178
Fessler,H., 895
Fisher,P.S., 1240, 1250
Fitch,R.A., 937
Flack,F.C., 1253
Florescu,N.A., 909
Fonda,L., 1211
Foreman,A.J.E., 1307
Fortunatova,N.N., 1058
Foster,E.L., 1333
Fouché,V., 1187
Fowler,P.H., 1176
Fowler,R.G., 1043
Fowler,W.A., 861
Frank,F.C., 1349
Frank,V., 1070-1
Franzini,P., 1208, 1212
Freier,P.S., 1115
Fremlin,J.H., 1097
French,A.P., 1255
Fretter,W.B., 1107
Freymann,R., 1033
Fridman,V.M., 921
Friedman,H.L., 906
Froissart,M., 883
Fujita,J.-I., 1249
Fulop,W., 897
Fumi,F.G., 1317
Furduev,V.V., 929
Furuichi,S., 1182

Gafner,G., 1008
Galbraith,W., 1194
Galkin,A.A., 1069
Gallagher,L.R., 1145
Gambling,W.A., 1065
Gardner,J.W., 1159
Garg,J., 1266
Garland,C.W., 1305
Garstang,R.H., 950
Garton,W.R.S. (Conf.rep.), 1073
Gatto,R., 1209
Gay,P. (Conf.rep.), 1368
Gaydon,A.G., 963
Geake,J.E., 848
Gealer,R.L., 1020
Gerson,N.C., 1379
Gerstein,G., 1258
Giacoletto,L.J., 1062
Gibbons,J.H., 1256-7
Gibson,W.M., 1146
Gierula,J., 1117
Gilboy,W.B., 1180
Giles,P.C., 1184
Gilham,E.J., 1005
Glaser,D.A., 1208, 1212-13
Glaser,V., 874
Glasser,R.G., 1198
Glinchuk,K.D., 1058
Gloersen,P., 946
Gluckstein,M.E., 1021
Godnev,I.N., 1289
Gofman,I.I., 1091
Gollop,J.B., 1384
Good,M.L., 1207
Good,R.J., 1032
Goodman,L., 1290
Goodwin,D.W., 1067
Gottstein,K., 1207
Gozzini,A., 960, 971
Grace,M.A., 1233
Gracheva,T.I., 943
Graham,J., 1339
Graves,C., 1208, 1212
Greenhow,J.S., 856
Gregory,B.P., 1205
Gregory,R.L., 1394
Griem,H., 951
Grillot,E., 1033
Groth,W., 1286
Grünbaum,E., 1129
Grunwald,E., 1358
Gubanov,A.I., 1047
Guile,A.E., 1075
Gupta,M.R., 1109
Gupta,R.K., 1232
Gürsey,F., 1163

Hadley,D.W., 1240
Hagedorn,F.B., 1223
Hagène,B., 1034
Hagene,M., 1033
Hall,J.F.,Jr, 993
Hall,L.A., 985
Hall,R.C., 1127
Hancox,R., 1082
Hanna,S.S., 1242
Hansen,L.F., 1107
Hansen,N.R., 1151
Harmon,N.F., 1175
Harrer,J.W., 1271
Harris,R.D., 1384
Haseda,T., 1132
Haug,A., 1309
Havas,P., 871
Havlovic,V., 1374
Hawkins,T.D.F., 860

Hayward,R.W., 1243
Heap,H., 1333
Heckman,H.H., 1184
Henley,E.M., 1254
Hennessy,J., 1187
Hereford,F.L., 1268
Herscher,L.W., 959
Hihara,T., 1128
Hill,R.S., 1260
Hillas,A.M., 1180
Hillion,P., 1275-6
Hinds,S., 1222, 1261
Hirahara,E., 1128
Hirsch,P.B., 1371
Hoare,F.E., 1030
Hobstetter,J.N., 1051
Hoffmann,K.W., 988
Hofsommer,D.J., 935
Holland,L., 991
Hooton,D.J., 1306
Hopkins,H.H., 942
Hopkins,M.R., 901
Hoppes,D.D., 1243
Horne,R.W., 1341, 1363
Hostettler,H.U., 907
Houghton,J.T., 860
Houtermans,F.G., 1238
Howarth,C.I., 1394
Hoyle,F., 861
Hudson,R.P., 1243
Huggett,R.W., 1193
Hughes,V.W., 1185
Hume-Rothery,W., 1337
Hunter,S.C., 1354
Husimi,K., 1035
Hutchison,C.A., Jr, 1279
Huybrechts,M., 1236
Hyslop,J., 1287

Iglitsyn,M.I., 1059, 1063
Iida,S., 1133
Inghram,M.G., 1298-9
Inman,F.W., 1184
Iori,I., 1238
Irland,M.J., 975
Ishikawa,G., 1118
Ivanov,A.P., 981
Iyengar,K.S., 1002

Jack,W., 1225
Jacobsohn,B.A., 1254
Jaffray,J., 1018
Jean,M., 1218
Jefferies,J.T., 858
Jeffreys,H., 919
Jensen,E., 1136
Jerison,H.J., 1386
Jha,S., 1232
Joel,N., 1343
John,W., 1192
Jones,D.A., 1321
Jones,E.R., 899
Jones,G.L., 1255
Jones,G.O., 1304
Jones,K.W., 1256
Jones,P.B., 1202
Jurak,A., 1117
Jürgensen,K.H., 1336

Kahana,S., 1247
Kan,Ya.S., 1069
Kanda,E., 1132
Kanevskiĭ,I.N., 924
Känzig,W., 1314
Karstensen,F., 1335
Kataoka,K., 1035
Katz,E., 1405
Kavadas,A.D., 1078
Kawaji,S., 1053
Kayas,G., 1187
Kelen,A., 1064
Keller,A., 1349
Kelley,R.J., 1020
Kellogg,P.J., 1380
Kemp,J.F., 902, 912
Kepler,R.G., 1107
Kessler,P., 1158
Khastgir,S.R., 1382
Kieffer,J., 916
King,I.R., 1359
Kipfer,P., 977
Kittel,C., 1121
Kiyasu,Z., 1035
Klemperer,W., 914
Knapp,V., 1226
Knipper,A.C., 1224
Kobayashi,A., 1053
Kobayashi,S., 1122
Koelsch,A.C., 1037
Kogan,I.N., 925
Kok,J.A., 1072
Kolesnikov,V.N., 1081
Kolomiets,B.T., 1048
Kontsevoĭ,Yu.A., 1059, 1063
Kopra,L.L., 1399
Kornfel'd,M.I., 1011
Korringa,J., 1040
Kosman,M.S., 1328
Krauss,M., 1288
Krohn,V.E., 1173
Kropf,A., 1288
Krotova,N.A., 1353
Kuhlmann-Wilsdorf,D., 1324
Kümmel,H., 1219
Kuni,F.M., 1171
Kuperman,S., 1162
Kuznetsova,L.A., 986

Lacroix,R., 1278
Ladu,M., 1149
Lamb,J., 923
Lambertson,G.R., 1194
Lameau,J., 869
Landsberg,P.T., 1044
Landwehr,G., 898
Lashkarev,V.E., 1056, 1066
Latham,R. (Conf. rep.), 1073
Lattes,C.M.G., 1186
Launey,J., 1061
Laval,J., 1301-3
Lazarev,B.G., 1069
Lazzarini,E., 1239
Le Bot,J., 1033
Lee,E.W., 917
Lee,P.M., 1320
Le Fèvre,J.J., 1034
Lehmann,H., 874
Leibowitz,H., 1398
Leontovich,A.M., 962
Leprince-Ringuet,L., 1205
Lewis,G.M., 1251
Lewis,T.J., 1075
Lidiard,A.B., 1322
Lidofsky,L.J., 1244
Lifson,S., 905
Lindberg,V.L., 975
Lindgren,P.H., 1369
Lipkin,H.J., 1162
Lipworth,E., 1283
Lisitsa,M.P., 1001
Litovchenko,V.G., 1056
Llewellyn,J.P., 1013
Loewenstein,A., 1358
Logie,H.J., 989
Lohrmann,E., 1199
Lomer,W.M., 1281, 1307
Lomon,E.L., 1189
Lonati,R.D., 1238
Lovick,F.W., 1143
Lowenthal,G.C., 1026
Lüders,G., 1248
Luscombe,G.W., 1142
Lyman,E.M., 1207

McConnell,H.M., 1357
McCormac,B.M., 1268
McDowell,S.W., 1183
McEwen,J.G., 1146
McGuire,P., 1398
Mackay,D.M., 1389
McKay,H.A.C., 1231
McKay,R.W., 1078
Mackenzie,D.K., 1352
Mackie,A.G., 900
Macklin,R.L., 1257
MacLean,C., 1131
McManus,G.M., 1003
McNally,J.R., Jr, 1080
Madan,B.K., 1232
Maeda,K., 1118
Magun,S., 1336
Mande,C., 1083
Mandl,F., 1155
Mannelli,I., 1208, 1212
Manning,A.W., 1108
March,N.H., 1085, 1284, 1320
March,P.V., 1267
Marcus,R.A., 1360
Marquez,L., 1116
Marshak,H., 1256
Marshak,R.E., 1177, 1216
Marshall,W., 1281
Marty,C., 1259
Marx,G., 1152
Mason,P., 1253
Massey,H.S.W., 1169
Matejec,R., 1046
Mathewson,D.S., 850
Matsukawa,E., 1166
Matthews,J.C., 1030
Matumoto,Z.-I., 1249
Matveev,A.N., 1086-7
Mau Vinh, 1245
Mays,J.M., 1120
Mehta,S.F., 1075
Meiboom,S., 1358
Meissner,K.W., 949
Meltzer,B., 1105
Menes,L.I., 925
Metzner,A.B., 1351
Meyer,D.I., 1213
Meyer,G., 1167
Meyer,P., 1259
Michelini,A., 1210
Middleton,R., 1222
Mięsowicz,M., 1117
Mikhaĭlov,I.G., 1344
Millar,B., 1096
Milosavliévitch,D., 903
Milsted,J., 1231
Minshall,F.S., 1355
Miselyuk,E.G., 1058
Missert,R.F., 1114
Mitchell,A.H., 1123
Mitchell,J.W., 1068, 1321
Mitra,S.S., 1388
Miyamoto,K., 939
Mogford,I., 1332
Möglich,F., 1106
Moneti,G.C., 1210
Monterie,F., 1101
Montmory,R., 1015
Morgan,J., 1149
Morgenshtern,Z.L., 983
Morimoto,T., 1156
Morita,M., 1241
Morozova,L.P., 1353
Morrison,J.A., 1029
Morton,W.T., 1267
Moss,T.S., 860
Mott,N.F., 1310
Moussa,A.H.A., 1169
Mukhopadhyay,H., 891
Muller,F., 1205
Müller-Hillebrand,D., 1381
Mullins,J.H., 1145
Munro,G.H., 1377
Murakami,M., 1128

Nakamura,S., 1249
Nambu,Y., 872
Nango,R., 1393
Nann,E., 1286
Nash,W.F., 1181
Neizvestnyĭ,I.G., 1057
Neufeld,E.L., 856
Newcomb,T.P., 1352
Newey,C.W.A., 1322
Newson,H.W., 1256
Niblett,D.H., 1345
Niederer,J., 1258
Nikolić,M., 1199
Nogami,Y., 1170
Nordhagen,R., 1270
Norton,L.E., 956
Novey,T.B., 1173
Novick,R., 1283
Novitskiĭ,B.G., 921
Novototskii-Vlasov, Yu.F., 1057
Nydal,R., 1227

Oatley,C.W., 1093
O'Brien,B.J., 1147
O'Brien,P.A., 853
O'Brien,V., 1396
Occhialini,G., 1149
O'Connor,A., 1349
Okada,J., 1052
Ollerton,E., 895
Omel'yanovskaya,N.M., 1056
Omnès,R., 883
Ornella,L.F., 1021
Oster,G.K., 1360
Ottewell,R.H., 1363
Ovander,L.N., 970
Owen,J., 1316

Palmer,C.H., Jr, 965-6
Pankratov,N.A., 947
Papazian,H.A., 1300
Pappalardo,R., 964
Parfianovich,I.A., 978
Parikh,V.R., 1187
Parrott,J.E., 1045
Parry,G., 1222, 1261
Pattison,J.R., 918
Paulus,M., 1125
Pauncz,R., 889
Pawsey,J.L., 850
Penkin,N.P., 1077
Penning,P., 1325
Perkins,D.H., 1176
Perl,M.L., 1208, 1213
Perlman,I., 1237
Pernegr,J., 1117
Peyrou,C., 1205
Picciotto,E., 977
Piddington,J.H., 857
Pieraccini,F., 1179
Pillet,G., 1375
Pimentel,G.C., 1294-5
Pisarenko,V.F., 1329
Plano,R., 1208, 1212
Plonsey,R., 1140
Pluvinage,P., 1215
Pohl-Rüling,J., 1111
Pointon,A.J., 1181
Pokhil'ko,L.G., 1081
Polovin,R.V., 1088
Pound,R.V., 934
Powell,R.W., 1042
Powles,J.G., 1221
Prange,R.E., 888
Pratt,P.L., 1322
Pratt,R.H., 888
Premaswarup,D., 954
Prentki,J., 880
Preston,R.S., 1242
Pribytkova,N.N., 944
Price,F.V., 1260
Proctor,W., 1025
Prodell,A., 1208, 1212
Proriol,J., 1215
Puppi,G., 1208, 1212
Purcell,E.M., 1174
Pursey,D.L., 1247
Putner,T., 991

Quinn,J.J., 1165

Raboy,S., 1173
Radakrishnamurty,C., 1372
Raimes,S., 1308
Rajopadhye,V.Y., 1263
Ramsey,N.F., 1174
Ravenhall,D.G., 1164
Raynor,G.V., 1016, 1339
Rebka,G.A., Jr, 934
Redding,G.B., 1323
Redheffer,R.M., 1031
Rees,J.R., 1262
Regge,T., 870, 882
Rennie,A.E., 1067
Replogle,F.S., Jr, 1144
Riazuddin, 884
Rice,S.A., 914
Rieser,L.M., Jr, 1084
Rimmer,D.E., 1338
Ringo,G.R., 1173
Roaf,D., 1260
Robertson,H.H., 1265
Robinson,D.W., 1401
Rodionov,S.F., 1378
Rosendorff,S., 1157
Rossberg,D., 1346
Rothem,T., 1162
Rowlands,G., 1135
Roy,S.K., 843-5
Rozenberg,L.D., 924, 926
Rozman,I.M., 987
Ruhl,H.D., 959
Russell,M.C.B., 1150
Ryter,C., 1277
Rzhanov,A.V., 1057

Sachs,R.G., 1190
Sahasrabudhe,P.W., 1372
Sakudo,T., 1036
Sakuntala,M., 1043
Sakurai,J.J., 1214
Sal'kov,E.A., 1066
Samios,N., 1208, 1212
Sampson,M.B., 1262
Sands,M., 1191
Santangelo,R., 1208, 1212
Sard,R.D., 1175
Sato,T., 1376
Sawada,S., 1182

Sawicki,J., 1246
Sawyer,B., 1126
Schenck,H., Jr, 1373
Schmidt,P.W., 904
Schneeberger,M., 1199
Schneider,W., 1094-5
Schöpf,H.G., 1138
Schutten,J., 1101
Schwartz,M., 1208, 1212
Scott,J.M.C., 1161
Seeley,J.S., 860
Seeman,N., 1198
Sekizawa,H., 1133
Sen Gupta,S., 891
Septier,A., 1099-100
Servi,I.S., 1367
Shamovskiĭ,L.M., 979, 983
Shaw,E.A.G., 1384-5
Sheard,A., 1049
Sheĭnkman,M.K., 1066
Shersby-Harvie,R.B.R.-, 1137
Sherwood,J.W.C., 920
Shirokov,V.I., 986
Shishlovskiĭ,A.A., 1001
Shklyarevskiĭ,I.N., 976
Shkolnik,V., 1168
Shmit,O.A., 1330
Shukhtin,A.M., 945
Shull,H., 1290
Shul'man,S.G., 974
Shuppe,G.N., 1091
Shute,G.G., 1250
Sidorov,A.I., 1059, 1063
Siekman,J.G., 1235
Sigmond,R.S., 1227
Signell,P.S., 1216
Silvestrini,V., 1208, 1212
Simpson,J.A., 1112
Sinel'nikov,K.D., 976
Singer,K., 1297
Skidmore,M.R., 1080
Slater,N.B., 1292
Slowinski,E.J., Jr, 1007
Slutsky,L.J., 1305
Slykhouse,T.E., 937
Smidt,J., 1312
Smirnov,B.G., 1091
Smirnov,L.S., 1060
Smith,D.S., 958
Smith,F.G., 853
Smith,F.M., 1184
Smith,J.H., 1174
Smith,R.W., 1016
Smith,T., 1013
Smith,W.J., 941
Smoluchowski,R., 1126
Snow,G.A., 1198
Sodha,M.S., 1388
Solmitz,F.T., 1207
Solomon,I., 1311
Solov'ev,V.A., 1344
Soper,J.M., 1217
Speers,G., 1240
Spirin,G.S., 1091
Spokes,G.N., 963
Spreadborough,J., 1327
Srivastava,R.S., 1382
Standil,S., 1168
Standley,K.J., 1315
Steeb,S., 1336
Steinberger,J., 1208,1212
Steppuhn,A., 1038
Sterin,Kh.E., 968
Steuer,M.F., 1268
Stevens,K.W.H., 1310
Stevenson,M.L., 1207
Stevenson,R., 1017
Stockhausen,J.H., 1113
Stoppini,G., 1192
Strauch,K., 1258, 1270
Strikha,V.I., 1056
Stuart,G.A., 1105
Stumpers,F.L.H.M., 892
Sudarshan,E.C.G., 1177
Suffczyński,M., 1264
Svedberg,P., 1064
Sverdlin,A.S., 1289
Sveshnikov,B.Ya., 986
Swart,J.J., 1216
Szymanski,J., 1246

Takahashi,Y., 893-4
Tanaka,G., 1208
Tanaka,H., 1212
Tanikawa,Y., 881
Tantry,B.A.P., 1382
Tatevskiĭ,V.M., 969
Tauc,J., 1090
Taylor,A.E., 1172
Taylor,C.A., 1370
Taylor,R T., 1233
Taylor,W.G.A., 998
Teale,R.W., 1135
Teem,J.M., 1145
Telegdi,V.L., 1173
Temperley,H.N.V., 915
Tennent,R.M., 1180
ter Haar,D., 885
Tewordt,L., 1326
Thackeray,D.P.C., 1076
Theis,W.R., 886
Thiessen,G.J., 1384-5
Thomas,D.G.B., 899
Thomas,T.S.E., 1009
Thompson,B.J., 1370
Thompson,R.W., 1193
Thurlow,W.R., 1402
Ticho,H.K., 1207
Tinlot,J.H., 1205
Tiomno,J., 879
Tkachuk,A.M., 980
Tkachuk,N.N., 980
Tolstoĭ,N.A., 980
Tonge,D.G., 1134
Tongiorgi,E., 1238
Tonning,A., 1141
Torki,B., 1266
Torrey,H.C., 1293
Tosi,M.P., 1317
Touchard,J., 1218
Townes,B.M., 1270
Toye,T.C., 899
Treacy,P.B., 1233
Trefethen,L., 1014
Trilling,G., 1187
Trurnit,H.J., 1003
Truss,C.V., 1392
Tsintsadze,N.L., 1088
Tulub,A.V., 913
Tye,R.P., 1042
Tyulin,V.I., 969

Ukhanov,Yu.I., 974
Umezawa,H., 893-4
Unal,B.C., 865-6
Urlau,R.R., 989
Ushanova,N.I., 1289

van Bergeijk,W.A., 1383
v.d.Hauw,T., 1101
van der Pauw,L.J., 1039
van der Waals,J.H., 1131
Van Thiel,M., 1294-5
Varma,J., 1225
Velde,J.V., 1213
Vengel',T.N., 1048
Venkateswarlu,P., 952-3
Verma,R.D., 952-3
Vigier,J.P., 865-6
Vincent,D., 1085
Vinh Mau, 1245
Vitale,B., 1188, 1195-6, 1201, 1203
Vlasenko,N.A., 976
Volosok,V.I., 1089
Vrána,J., 1117

Waddington,C.J., 1263
Wadhwa,Y.D., 911
Wali,K.C., 1190
Waloschek,P., 1199, 1212
Walraven,P.L., 1391
Ward,W.D., 1400
Watanabe,Y., 1055
Weale,R.A., 1395
Webber,A.C., 973
Webster,H.R., 1384
Weinreb,A., 984
Weir,A., Jr, 1020-1
Welge,K.H., 1286
Wenzel,A., 961
Wenzel,W.A., 1194
West,E.J., 938
Westfold,K.C., 859
Wheatley,P.J. (Conf. rep.), 1368
Whelan,M.J., 1371
Whitehouse,D.R., 1144
Wijnen,M.H.J., 1361-2
Wikner,E.G., 1282
Wilcock,W.L., 848
Wilkins,J.E., Jr, 1404
Wilks,J., 1024, 1345
Williams,G.T., 922
Williamson,R.M., 1256
Wilson,R.R., 1119
Winslow,J.W., Jr, 1032
Winter,R.G., 1153
Winternitz,J., 954
Winzeler,H., 1199
Wohlfarth,E.P., 1134
Wolcott,N.M., 1027
Wolf,E., 931
Woloschek,P., 1208
Wolter,W., 1117
Woodruff,T.O., 1314
Wooster,W.A., 1343
Wright,N., 959
Wright,R.W., 1050
Wyszecki,G.W., 1390

Yamaba,M., 1249
Yamazaki,M., 1291
Yennie,D.R., 1164
Yoffe,E.H., 1318-19
Yonemura,D., 1393
Yonezawa,M., 1182

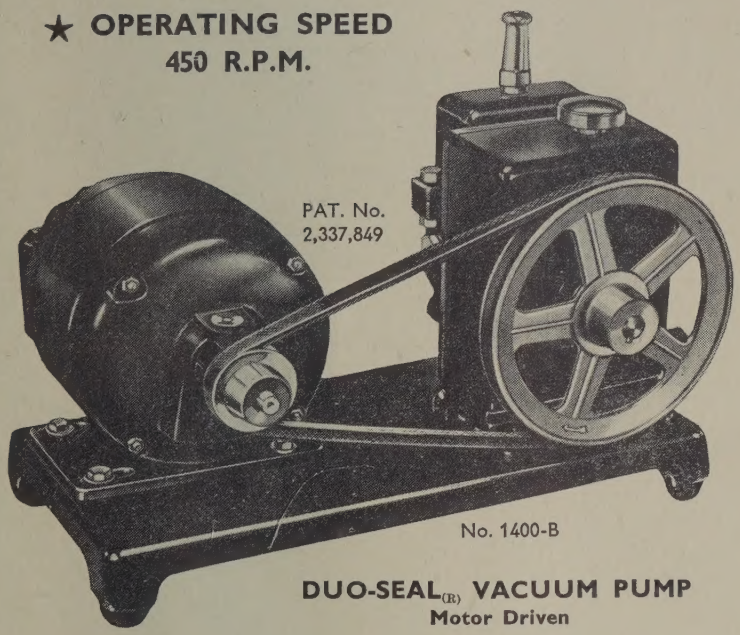
Zaidi,M.H., 1189
Zavattini,E., 1210
Zeeman,P.B., 954
Zhvanko,Yu.N., 979, 983
Zichichi,A., 1210
Ziegler,G., 1346
Zimmer,K.G., 987
Zimmermann,W., 874
Zobel,K.F., 898
Zoboli,V., 1208, 1212
Zorn,B.S., 1200
Zorn,G.T., 1200
Zwislocki,J., 1403

An All-Around Time-Tested WELCH
TWO-STAGE DUO-SEAL® VACUUM PUMP

★ **GUARANTEED VACUUM—0.1 Micron (.0001 mm Hg)**

★ **FREE AIR CAPACITY 21 Liters per minute**

★ **OPERATING SPEED**
450 R.P.M.



No. 1400-B

DUO-SEAL® VACUUM PUMP
Motor Driven

VISIBLE OIL LEVEL
No- Splash—No Oil Back-up

- **Quiet**
- **Durable**
- **Efficient**
- **Economical**

The ideal pump for general use in industrial and educational physics laboratories.

Two stages of the DUO-SEAL movement are incorporated in the construction of this model. It is a popular pump especially suitable for educational and industrial physics laboratories, although it is widely used elsewhere as well. The exceptionally quiet operation is an advantage in the classroom and laboratory, and the ultimate vacuum is ample for all mechanical-pump requirements.

MOTOR 1/3 HP—1725 R.P.M.
Overall Dimensions of Mounted Pump
$17\frac{1}{8}$ x $10\frac{1}{2}$ x $12\frac{5}{8}$ inches high
BELT-TIGHTENING Provision
EXTRA SUPPLY of Duo-Seal Oil

PRICE Complete with Motor	**$133.00**
Totally Enclosed Belt Guard for No. 1400 B Pump	**$15.00**

Write for our Meter Catalogue

W. M. WELCH SCIENTIFIC COMPANY

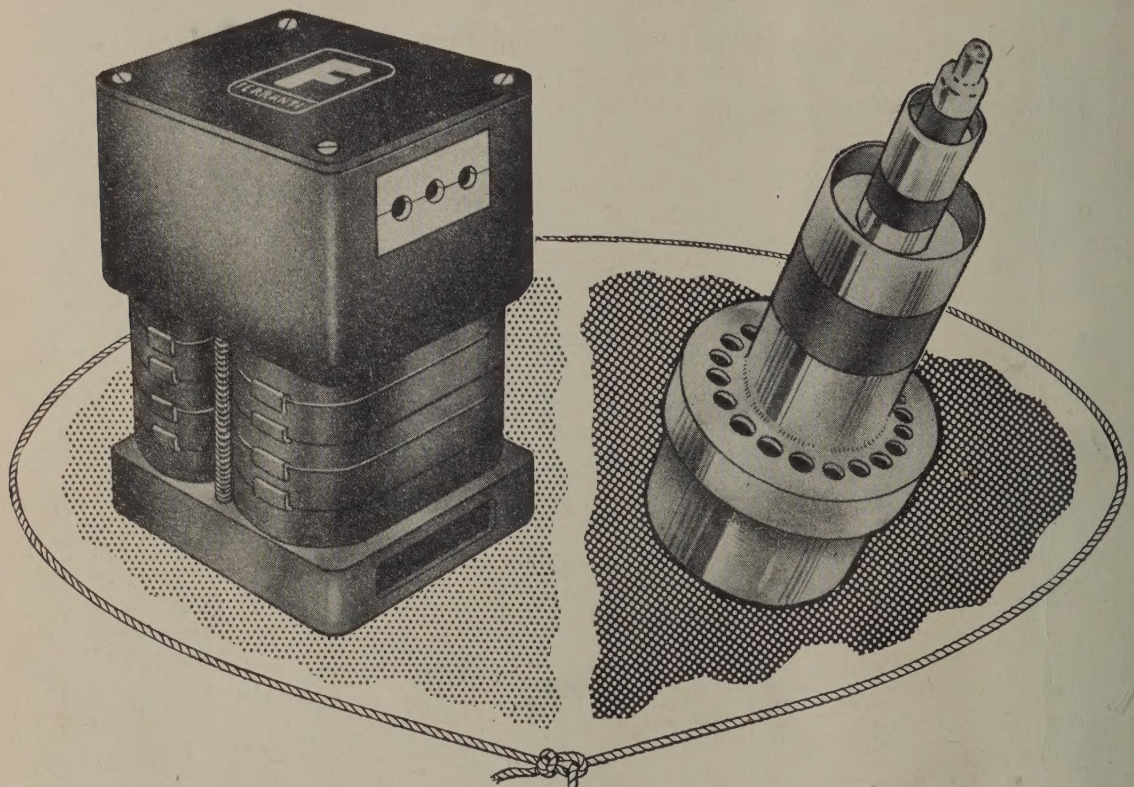
DIVISION OF W. M. WELCH MANUFACTURING COMPANY

ESTABLISHED 1880

1515 Sedgwick Street, Dept. PA Chicago 10, Ill., U.S.A.

Manufacturers of Scientific Instruments and Laboratory Apparatus

bigger smaller and better!



"Hitemp" Transformers

- Operational temperatures up to 250°C.
- Suitable for high altitude operation.
- Saving in size and weight.

Originally designed for supersonic aircraft, the "Hitemp" range of transformers has many applications throughout the electrical field.

Ceramic Valves

- High permissible temperature of operation.
- Ruggedised construction.
- Reduced dimensions.

The Ferranti range of Ceramic Valves includes power rectifiers, stabiliser triodes and R.F. power oscillators and amplifiers.

FERRANTI

FERRANTI LTD., FERRY ROAD, EDINBURGH · Tel: Granton 89181

ES/T36

Visit our Stand No. M9 at the A.S.E.E. Exhibition, March 25th to 29th.